BOOK REVIEW

THE ILLUSTRATED ENCYCLOPEDIA OF ELEPHANTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Charles Santiapillai

DIARY

1. WORKSHOP ON THE BIOLOGY OF FOREST ELEPHANTS

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

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

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

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

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