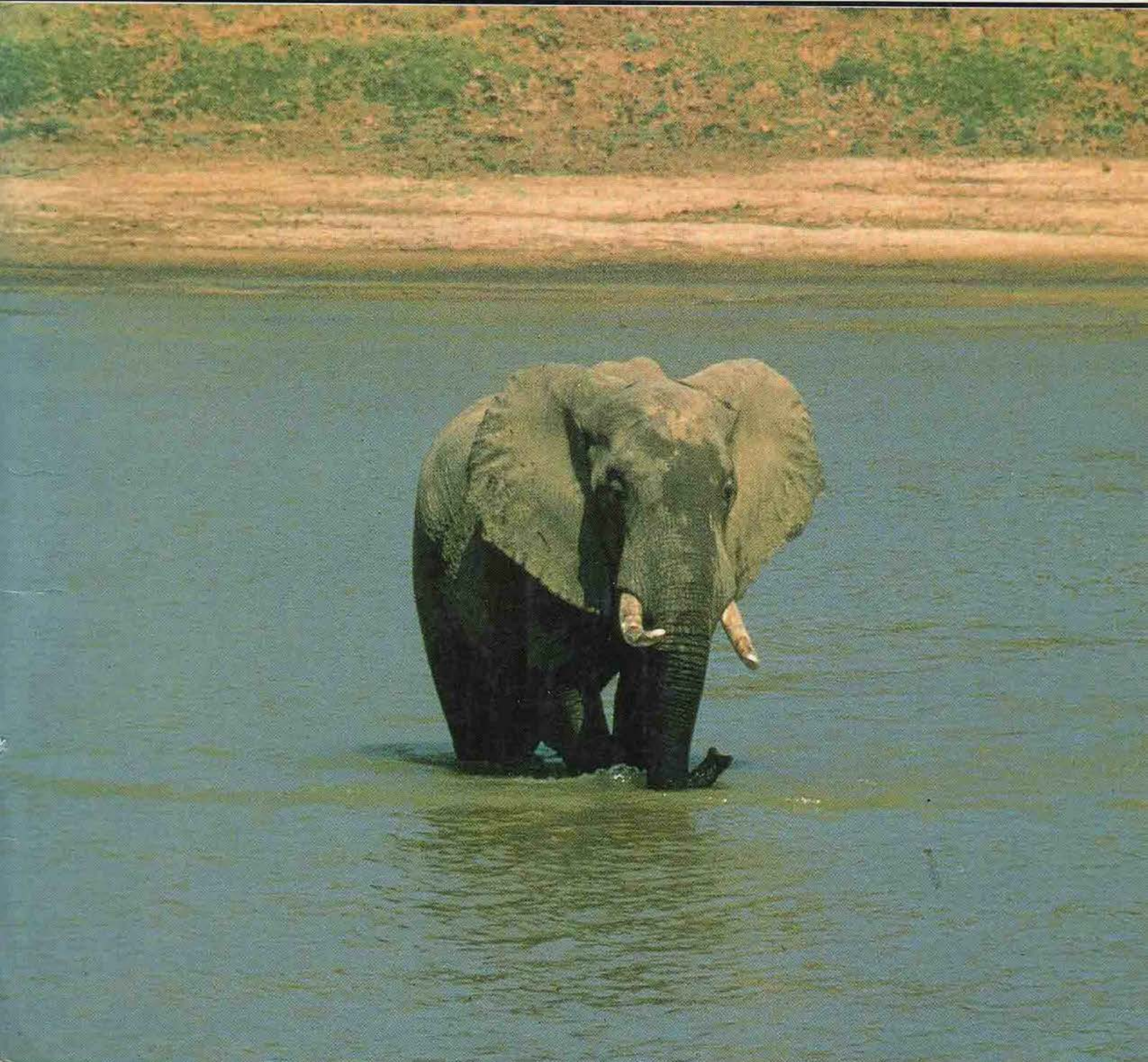
UNEP/GEMS Environment Library No 3

THE AFRICAN ELEPHANT



United Nations Environment Programme
The African Elephant
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United Nations Environment Programme
PO Box 30552
Nairobi, Kenya

Text and lay-out: Robin Clarke and Imogen Bertin
Artwork: Nigel Jones

THE AFRICAN ELEPHANT

The UNEP/GEMS Environment Library

UNEP's Global Environment Monitoring System (GEMS) now has more than a decade of solid achievement behind it. In that time, we have helped make major environmental assessments of such things as the state of urban air pollution, the greenhouse problem, the rate of degradation of the world's tropical forests and the numbers of threatened species in the world.

As is proper, the results of these assessments have been regularly published as technical documents. Until now, however, they have not been published in a form that can be easily understood by those without technical qualifications in the subjects concerned.

The aim of the UNEP/GEMS Environment Library is to rectify this omission.

This is the third volume in the series, and over the coming months and years we plan to publish many more. Only in this way can the result of UNEP's environmental assessments become widely known. And only if they are widely known is public opinion likely to become sufficiently vociferous to demand that everything possible be done to halt the deterioration of our environment, and preserve for future generations the possibility to survive and flourish as we have been able to do.

Michael D. Gwynne, Director
Global Environment Monitoring System

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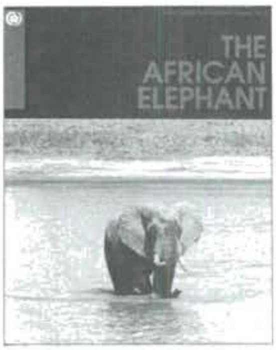


Cover picture shows an African elephant wading in the Luangwa River in Zambia

Foreword

Mostafa K. Tolba

The way in which the human species treats his fellow animals is often scandalous. The story that unfolds in these pages is one of the worst examples: over the past decade, elephant numbers in several African countries have been reduced by 90 percent or more. The immediate cause is undoubtedly reckless poaching on a grand scale; the underlying problem, which threatens the survival of the African elephant over the long term, is the relentless expansion of the human population.

The United Nations Environment Programme has long been concerned about the endangered species on this planet. This is not a matter of sentiment only. The genetic resources harboured by the animals and plants currently under threat from man are one of our most precious assets—assets without which our future progress could be severely curtailed.

It is, of course, imperative that the rural poor in developing countries should have access to the natural resources available in their own regions; in many areas, wildlife provides not only valuable extra food but also a unique opportunity to earn cash income on a sustainable basis. But it is not right that a small minority with access to automatic weapons should be able to reduce the population of a valuable species to levels that, in the end, will benefit no one.

The Convention on International Trade in Endangered Species—which UNEP was instrumental in establishing—has done much to improve matters. And I am delighted that the GEMS African Elephant Database study, made in collaboration with the World-Wide Fund for Nature and the Elsa Wild Animal Appeal, has been able to find a much improved method of providing African policy makers with the data they so badly need if they are to conserve and manage their elephant populations wisely in the future.

While the results of this study are only a first step, they are an important one. If African nations can now progressively enforce the sustainable quotas for ivory exports which they set, we will have gone a long way towards ensuring the survival of a species which, though not yet officially endangered, is under serious threat in many countries.

Mostafa K. Tolba
Executive Director
United Nations Environment Programme

Overview

The African elephant once roamed over nearly the whole of the African continent. Today its range is restricted to only a third of Africa's land area, and its numbers reduced to less than a million beasts.

Reaching a height of up to four metres, and weighing up to eight tonnes, the African elephant is bigger and differs in shape from its Asian counterpart. Unlike the Asian elephant, the African variety has never been domesticated on a large scale—though it is used for logging in parts of Zaire, and almost certainly was exploited by Hannibal in his crossing of the Alps.

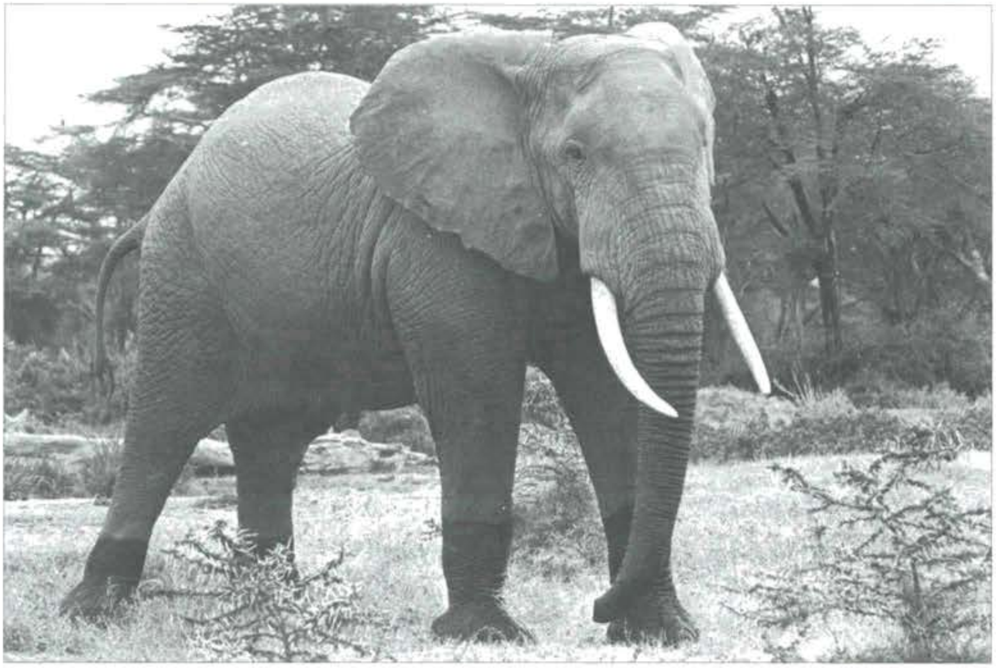
The fate of the elephant now hinges on the value set for its over-developed second incisors: its tusks.

Scientifically, there are many major gaps in our knowledge of the elephant. Controversy still surrounds the basic issue of whether or not dense populations of African elephants can co-exist with woodland; certainly, over the short term, they tend to destroy it, often changing the habitat into wooded grassland in the process. Nor is it fully understood how an animal that neither pants nor sweats can maintain its temperature at remarkably constant levels in the fierce heat to which it is often subjected.

The fate of the elephant now hinges on the value set for its over-developed second incisors: its tusks. The African elephant is being hunted, legally and illegally, and often with reckless abandon, for the value of the ivory it yields. In most African countries, the current off-take of ivory cannot be maintained for much longer; in some of them, another decade of poaching at current rates will see the elephant disappear altogether.

In most African countries, the current off-take of ivory cannot be maintained for much longer.

In 1985, a system of ivory export quotas was proposed by the parties to the Convention for International Trade in Endangered Species (CITES). The system has been operational since 1986, and invites countries to set quotas for ivory exports that can be maintained indefinitely on a sustainable basis. But because few African countries have reliable data on the size and range of their elephant populations, they have no accurate way of determining the levels at which to set their quotas. In 1986, UNEP's Global Environment Monitoring System, with funding from the World-Wide Fund for Nature and the Elsa Wild Animal Appeal, began work on a study designed to provide the missing information. The African Elephant Database study presented its report in June 1987.



African elephant in the Amboseli National Park, Kenya. Poaching is now rapidly reducing elephant populations in all but a handful of African countries

While there are substantial data on many elephant populations in Africa, they are of variable reliability and cover little more than a third of the animal's known range. The problem was thus to compile the data and to estimate elephant numbers and densities for the areas never surveyed. This was done with the help of the GEMS Global Resource Information Database (GRID), a computerized system for storing, manipulating and retrieving geographical information on many different environmental variables.

GRID enabled the researchers to look for correlations between elephant densities and such factors as protected areas, the presence of tsetse flies, type of vegetation, human population density, rainfall, and a number of socio-economic variables. Once these correlations had been established, the GRID computer was used to predict probable elephant densities in areas where surveys had never been carried out.

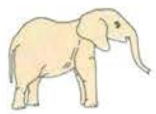
The results list likely elephant populations by country in each of 15 different types of vegetational area. As new information becomes available, it can be entered in the GRID computer which can thus provide results of ever-increasing precision. In this way, the results should eventually provide the basic data that policy makers in African countries need if they are to devise sensible plans for the management and conservation of their elephant populations. The study has also provided scientists and wildlife managers with a new means of assessing the population of any species—endangered or otherwise—in areas for which geographically-based environmental information is available.

The results should eventually provide the basic data that policy makers need if they are to devise sensible plans for the management of their elephant populations.

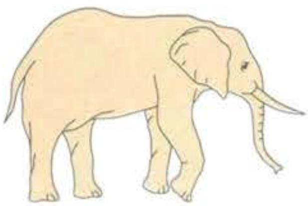
The scientific background

Elephants and men

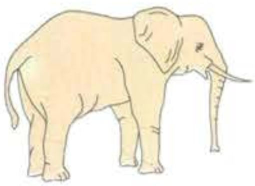
BODY SIZE



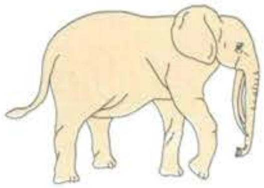
yearling African bull elephant: 1 metre tall



adult male bush elephant: up to 4 m tall, 8 tonnes in weight



female bush elephant: 45 cm shorter than the male



African forest elephant: smaller, with different tusks and ears

The African elephant, the largest living land mammal, is under threat. This extraordinary animal once roamed freely over nearly the whole of the African continent, but is now the victim of both human expansion and intensive poaching, mainly for the value of the ivory in its tusks. Were the species to be eliminated, the planet would lose one of its last links to the giant prehistoric mammals of the past; the ecosystems of which they form a part would be permanently altered; rural populations in Africa would have to forego a potentially important source of meat and income; and science would be deprived of an animal of great interest.

Biologically, elephants have a number of things in common with their most important predator, man. Both can live in a wide range of habitats, from desert to highland forests, and both prefer habitats where vegetation is abundant. Both can live for 60 or 70 years, though the average elephant lifespan is probably now less than 30 years. Puberty occurs in both species at about the same age. Like humans, elephants suffer from arteriosclerosis (hardening of the arteries) though the causes appear to be structural degradation of the long-lived elephant artery, rather than the stress and high cholesterol levels that currently plague the human species.

Although African elephants have been used in war (most famously in Hannibal's crossing of the Alps in the 3rd century BC), they have never been domesticated on a large scale, as have elephants in Asia.

Physically, African elephants differ from their Asian counterparts in several ways. They have larger ears, and lack the two prominent forehead bumps of the Asian elephant. Asian elephants have backs that curve up, whereas African elephants have backs that curve down. Both male and female African elephants have tusks, whereas female Asian elephants usually lack ivory. African elephants are about 45 cm taller than Asians, with males reaching as much as 4 metres in height. In both species, the female is about 45 cm shorter than the male. African males average about 5.5 tonnes, 20 percent more than Asians.

There are at least two sub-species of African elephant, *Loxodonta africana africana* (the bush or savannah elephant) and *Loxodonta africana cyclotis* (the forest elephant). Forest elephants are not as tall as bush elephants, and have smaller, rounder ears. Their heads are bent forward, and they have thinner, slightly curved tusks nearly reaching the ground.

On average one calf is born every four years, after a pregnancy lasting about 22 months. In harsh conditions, puberty occurs later, the interval between calves is longer, and the reproductive life of the cow is reduced. Calves weigh about 120 kg at birth, and are around one metre tall. They grow rapidly, and can reach as much as 420 kg in nine months.

Foraging takes about 16-18 hours in each day. An average elephant needs to consume about 22 kg dry weight of grass and woody vegetation each day to maintain its body weight. Large adult males sometimes consume as much as 75 kg, if the food available is of low quality with a high fibre content. To chew all this, elephants get through up to six sets of teeth during their lifespan.

There is controversy over what constitutes the preferred elephant diet but it includes most grasses and bushes, as well as the fruits, bark, leaves and branches of many trees.

Elephants depend heavily on the availability of water. In dry seasons, daily water requirements (up to 200 litres a day) keep elephants to within 25 km of water supplies.

They also need shade for protection against the mid-day heat, although they have efficient mechanisms for regulating their body temperatures under different conditions. In fact, elephants are found in habitats ranging from semi-desert to tropical rain forest, and at altitudes from sea level to 3 300 metres up Mount Kenya, where temperatures are always cool and sometimes cold.

Yet elephants cannot sweat and do not appear to pant. David Robertshaw and Peter Hiley studied elephants in Tsavo National Park, Kenya, where midday shade temperatures average 35°C. They found that the major heat loss is through radiation to cooler objects such as plants—hence the importance of shade. If water is available, elephants will wallow, covering and spraying themselves to keep cool. They are less active during the heat of the day. The elephant's large ears act as radiators to cool blood pumped through them but ear flapping does not increase cooling very much—though it does remove flies from the sensitive areas round the eyes. The elephant's dark grey skin is not much help, absorbing up to 85 percent of the energy striking it. Here again, behaviour seems to assist. Elephants frequently cover themselves with dust or mud, so that they are the same, lighter colour as their surroundings, and hence reflect more heat energy. Even so, the elephant's body temperature often increases by several degrees during the heat of the day.

Elephants appear to form two different kinds of social groups. Females may stay in their basic family unit throughout their lives; each unit comprises an average of some 4 cows and their calves, though the numbers can vary from 1 to 30. All ages are represented in the cow herd, and the cows cooperate in looking after calves. As numbers increase, the family unit often splits in two, though the sub-units normally retain some social ties. The males make up smaller bull herds of two or three

Elephants and trees

The eating habits of the elephant—which destroy trees and shrubs—may well be contributing to the fall in the numbers of African elephants.

Studies show that the proportion of browse to grass in the elephant's diet varies from equal parts to almost entirely grass, depending on availability. But it is not clear whether browse provides essential nutrients not available in grassy vegetation. There is some evidence that elephants whose diet is mostly grass are less healthy than those who mix grass and browse.

However, elephants often damage trees and woody vegetation; this damage, along with the effect of fire, can change bush landscapes to wooded grassland if populations are very dense. In other circumstances, tree browsing may stimulate new growth, and the elephant's habit of pushing trees over may promote habitat diversity.

As elephants are forced into confined areas by human expansion, the risk that elephant populations will turn woodlands into grasslands must increase. This is unlikely to benefit either elephants or humans. But studies of the natural rise and fall of elephant populations in protected parks have yet to show what outcome can be expected, and whether dense elephant populations are compatible with the long-term survival of woodlands.

TUSK SIZE

female bush elephant, 20 years old

male bush elephant, 20 years old

male forest elephant, 20 years old

male bush elephant, 35 years old

the heaviest recorded pair of tusks weighed 200 kg, and the largest were 3.5 m long

there are more than 40 000 muscles in an elephant's trunk

African elephants can pick up single blades of grass with their trunks

elephants appear to communicate over tens of kilometres by emitting low-frequency sounds

the average African male elephant weighs more than 70 adult men

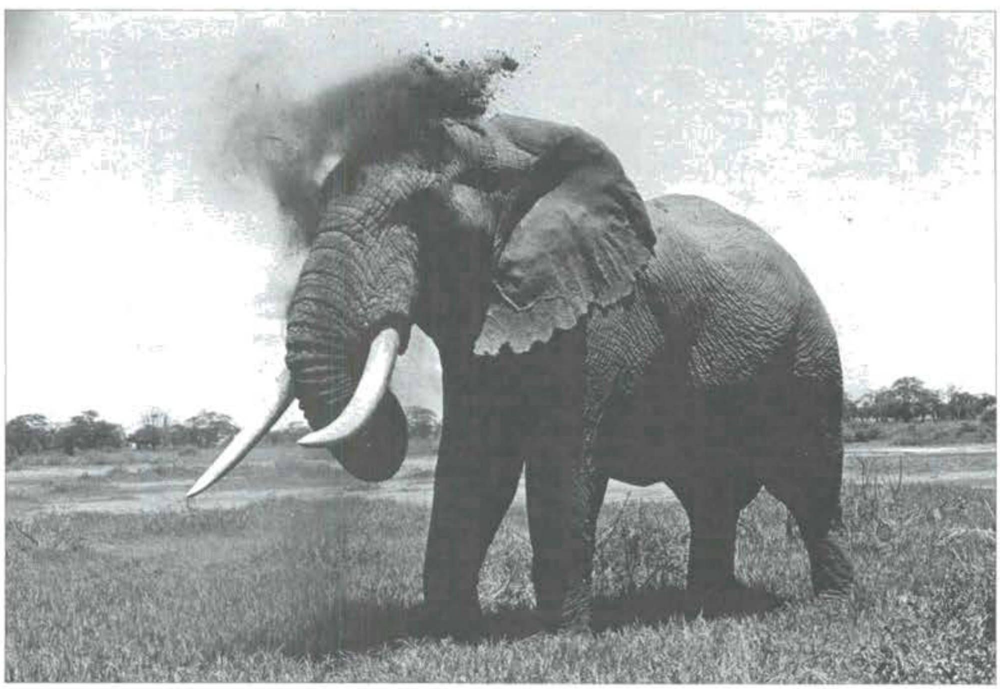
animals but these have a much more fluid and temporary composition.

In very dry areas, elephants migrate seasonally, sometimes travelling long distances in search of food and water. In some circumstances, herds then join into groups numbering 200-300 animals. Recently, Katy Payne has suggested that elephants communicate with one another over surpisingly large distances—tens of kilometres—using low-frequency vocalizations. Joyce Poole has conjectured that these calls may be used by females to coordinate the movements of both related and unrelated family units, by bulls to locate rival bulls and females in heat, and by both sexes to sound the alarm during poaching or culling operations.

Bush elephants have been far more closely studied than forest elephants, mainly because they can be seen more easily. Direct observations of forest elephants are almost impossible in tropical rain forest because of the dense vegetation, so indirect methods of estimating elephant densities, such as counting footprints, trails and droppings, must be used. Günter Merz, working in the Côte d'Ivoire, has noted that as there is sufficient food and water all year round, the forest elephant does not have to match the mobility of the bush elephant. Thus the annual home range is estimated at 150-200 km^2, in contrast to that of the bush elephant which, in dry climates, can be as high as 3 000 km^2. Like many other forest-adapted dwellers, the forest elephant forms small groups of three to four animals but does not appear to form larger population groups.

Unfortunately, the elephant's requirements for water, and its preferred

Elephants take dust baths frequently—one reason may be that the lighter colour they take on as a result enables them to cope better with high day-time temperatures



mosaic habitat of a mixture of bush and wooded grassland, have increasingly brought it into competition with human populations as the latter have expanded.

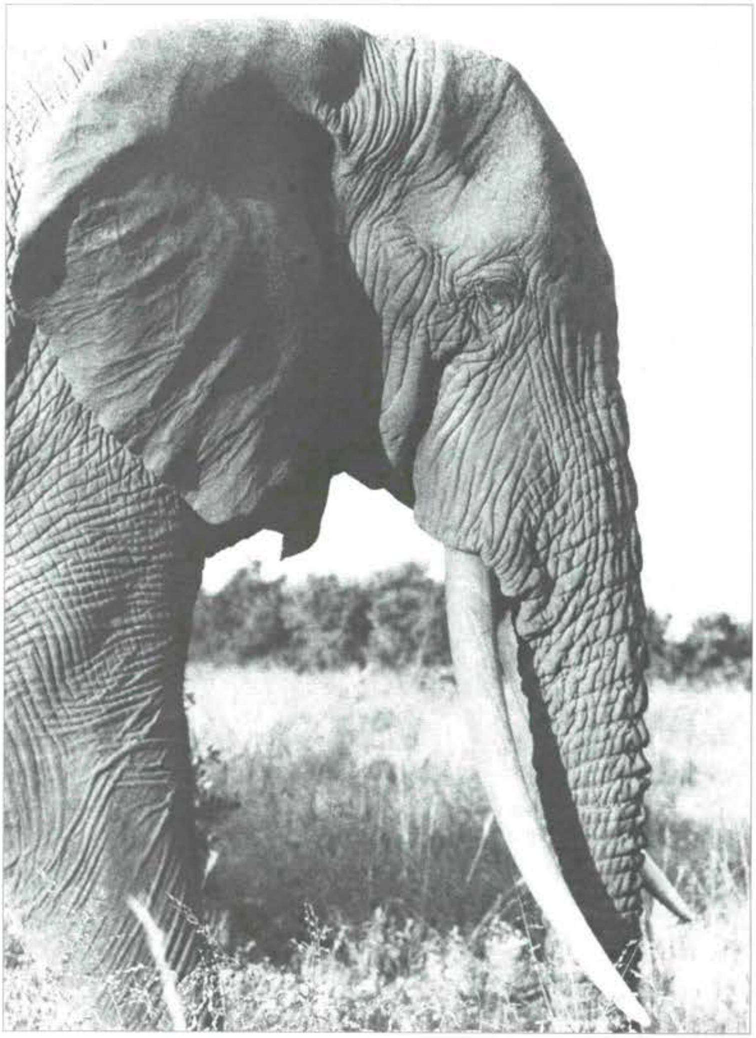
As farming encroaches on traditional elephant ranges, elephant crop damage can become increasingly severe and hence farmers shoot elephants. Elephants also damage managed woodland by eating young trees or pushing them over, and stripping the bark from mature trees. Over time, elephants are capable of converting woodland to much more open forms of wooded grassland. The problem is not only that young trees become replaced by fast-growing grass, but also that dead wood is left behind to serve as fuel for bush fires; the fires are much more destructive than was the original damage.

The populations of both bush and forest elephants are now undergoing rapid decline in many parts of Africa. There are two major issues to be considered.

The immediate, short-term problem is that of poaching, which is currently the major factor in reducing elephant populations. The problem is critical partly because the elephant has a fairly low rate of reproduction in the wild compared to other species. While growth rates of 4-7 percent are sufficient under benign conditions, they are too low to give the elephant much chance when poaching is intense. The effects of poaching are also exaggerated by the fact that tusks increase in size and weight with the age of the elephant. Since ivory traders prefer large tusks, older elephants tend to be selectively poached, removing from the populations only those individuals of reproductive age. This has a greater effect on elephant populations than would the random removal of the same number of elephants of all ages.

The second issue is the long-term problem of how well the elephant can co-exist with expanding human populations. Even if African elephant poaching could be eliminated, the threat to the species would not disappear. Destruction of the African rain forest, for example, is already putting pressure on the forest elephant; and the expansion of agriculture throughout Africa will, in the long term, mean that elephants will have to be excluded from large areas over which they formerly roamed freely.

The African elephant is distinguished from its Asian counterpart by its very large ears. Contrary to popular impression, ear flapping contributes little to cooling but is useful for removing insects from near the eyes



The rise and fall of the African elephant

Elephants once covered the whole of Africa in great numbers. Now they are mainly confined to a central geographical belt, and in many areas are suffering a dramatic decline in numbers. In East Africa, 95 percent decreases in population over the past ten years have been reported, and in only five countries—Botswana, Malawi, Namimbia, South Africa and Zimbabwe—are elephant populations stable or rising.

Ten millennia ago, elephants were present throughout the Saharan region; at that time, the Sahara had a more favourable climate, and much of what is now desert was grassland. In classical times, there were reports of elephants in the Mahgreb/Atlas mountain areas but, by about the 8th century, elephants were no longer found in North Africa. Ivory hunting may have been one of the causes of the demise of the North African elephant.

The rise of the slave trade in the 17th and 18th centuries was accompanied by a marked increase in the amount of ivory exported from Africa. The ships that carried the slaves also carried elephant tusks. As slaves and ivory became harder to find near the coast, traders moved further inland, building roads to service their settlements which were then used to transport ivory back to the coast. With the traders came guns, and firepower to kill elephants in great numbers—and with less danger to the hunters.

The 18th and 19th centuries saw the ivory trade associated with slaving first increase, and then diminish with the abolition of large-scale slaving. But the guns of the slavers were replaced by those of the 19th century European hunters. Ivory hunting apparently caused a population crash amongst the bush elephants during this period. The last elephant in the Hlabisi district of Zululand was shot in 1890, and this marked the virtual extinction of the elephant in most of South Africa.

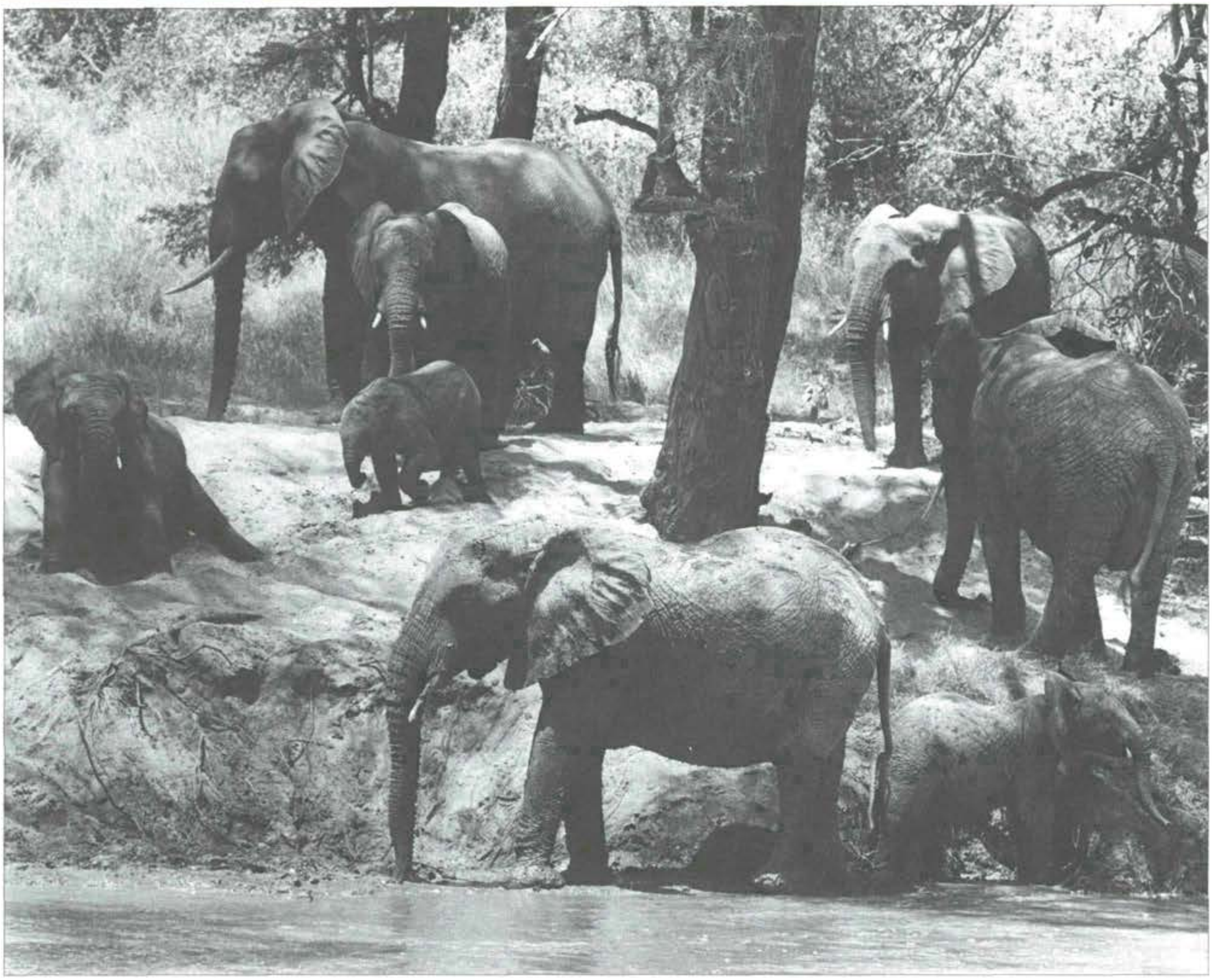
Population focus: Murchison Falls Park, Uganda

Twenty years ago, Murchison Falls Park was suffering from elephant over-population, and many elephants were shot to control numbers. Today the population has been reduced to a fraction of its former size, and numbers are still thought to be falling.

Aerial photographs of the park show that between 1932 and 1956 there was a 52 percent reduction in the number of large trees. Most of the formerly wooded southern sector had become open grassland by the early 1960s. During 1965-67 there was heavy control shooting of elephants. According to R. M. Laws, there were about 14 000 elephants in the park in 1966.

In 1979, retreating troops took to poaching as a means of survival. Others abandoned guns and uniforms in the Falls area to avoid capture. Local people acquired the guns and began poaching on a large scale.

By 1981 only 1 200 out of a 1973 population of 5 000 elephants remained in the sector of the Park north of the Nile, and a mere 160 out of 9 000 in the south. Two years later, according to Iain Douglas-Hamilton, the area was undergoing "a massive regeneration of woody vegetation, triggered by the decreased elephant density".



By the beginning of the 20th century, game laws restricting elephant shooting were being introduced in many countries. By 1920, many elephant populations appeared to be increasing and by the 1950s elephants were becoming an agricultural nuisance in many African countries. In Zaire, as many as 4 600 crop-raiding elephants had to be shot each year.

This pattern was not repeated all over Africa. In the Tsavo National Park in Kenya, poaching increased from 1945 onwards until a para-military operation in 1957 reduced illegal killing considerably. At the same time, new human settlements were established in areas surrounding the park; this encouraged the elephants to migrate into the protected areas, and led to a large increase in the elephant population.

In the 1960s, the vegetation in most East African parks and reserves began to alter, with formerly wooded areas turning into grasslands. Examination of the vegetation showed severe elephant damage to be a major cause of this change. In spite of bitter controversy, some parks began to cull elephants to reduce numbers.

A new wave of illegal elephant killing began in Kenya in 1971. It spread to East, Central and West Africa, and then to Angola, Zambia and Mozambique in Southern Africa.

By 1986, John Hart reported that in the Ituri forest, Zaire, elephant skeletons were scattered over a wide area. "The carnage in recent years", he wrote, " has been incredible".

In Zambia's Luangwa Park, aerial censuses showed a population of about 56 000 in 1973. This had reduced to 33 500 by 1979, and a 1987 count showed a further 40 percent reduction to about 20 000.

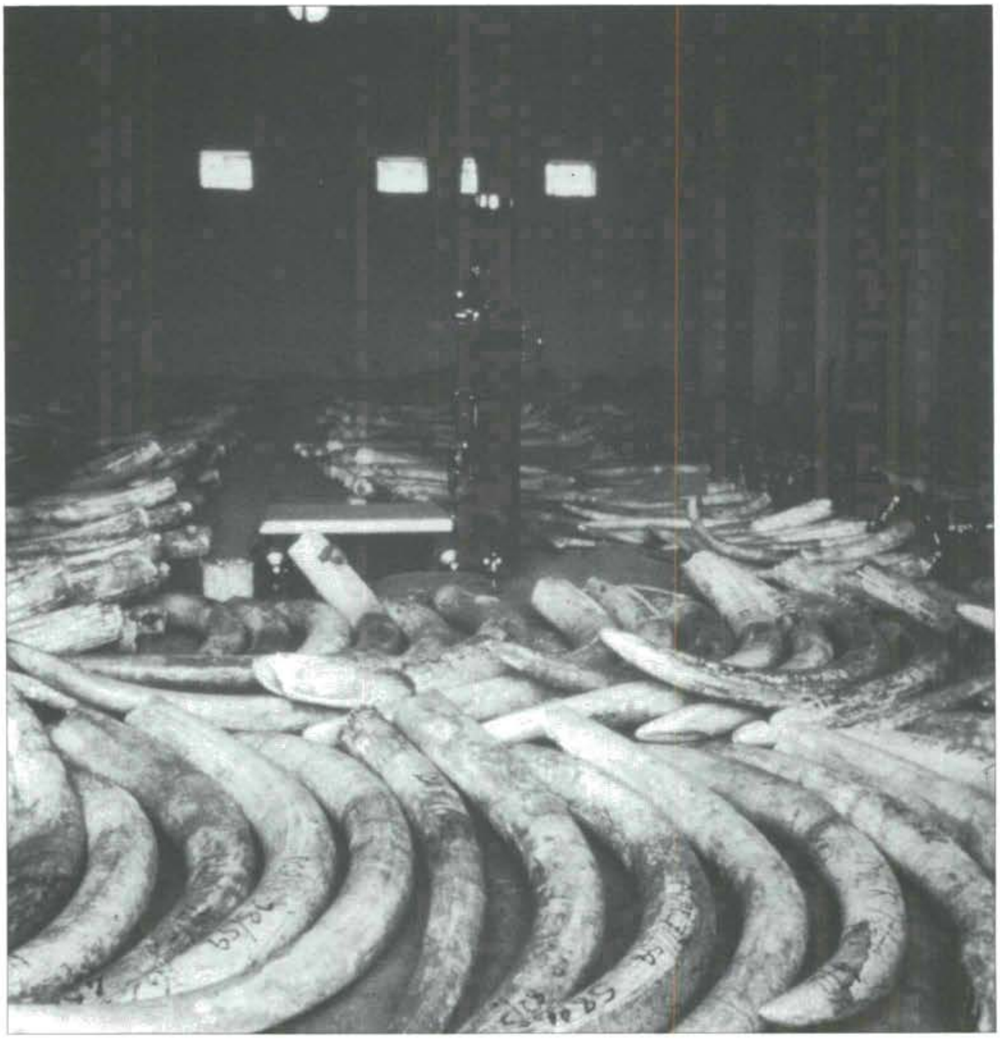
Over the past few years, the average tusk weight of commercial ivory has fallen dramatically—according to David Western, it fell from 10.1 kg in 1979 to only 6.2 kg in

Typical herd of cows and their young sheltering from the sun near water. The arrival of automatic weapons in Africa has meant that even young elephant, without tusks, may be indiscriminately slaughtered in the quest for ivory

1982. This suggests not only that the ivory is now coming from elephants with smaller tusks, but also that more females and young elephants are being killed. A 1986 survey of tusks from the Central African Republic showed none from animals over the age of 35.

Biologists concerned with African elephant populations became increasingly concerned about the situation during the 1980s. A report by the African Elephant and Rhino Specialist Group (AERSG) to CITES (the Convention on International Trade in Endangered Species) estimated that in 1987 the net rate of decline over the whole of Africa was 9.3 per cent, the equivalent of an annual off-take of 104 000 elephants. Since 1981, the report suggested, Africa's elephant population had declined by 36 per cent. The report concluded: "The downward trends for many countries are sufficiently large to

Stacks of tusks awaiting auction in the Ivory Room in Mombasa, Kenya



predict exctinction in the near future ... The situation is one of appalling conservation and mismanagement."

What has been happening over the past two decades to the African elephant population has been the subject of bitter controversy among the experts in the field. Initially, controversy centred on whether or not elephant populations were declining steeply, or whether other factors, such as improved techniques of estimating numbers and the movement of elephants into protected areas, were confusing the interpretation of data. That controversy, at least, is now resolved. There is now no doubt that elephant populations are being savagely reduced in all but a handful of African countries.

The second controversy was over what was causing the decline. The answer is over-hunting—but over-hunting for what reason? For ivory, for meat, as a means of protecting agricultural crops? Or just as an inevitable result of the expansion of human settlements? This controversy has been resolved much more slowly.

Population focus: Zimbabwe

Through careful planning and control, Zimbabwe has managed to build up its elephant population after the near-disastrous crash that occurred early in the century as a result of big-game hunting. Zimbabwe probably now has ten times as many elephants as in 1900.

Zimbabwe began to manufacture ivory artefacts in addition to its existing ivory export trade in 1973. All ivory workers and the ivory they use now have to be registered, and there is little illegal trading. During 1982, this domestic trade consumed 15 tonnes of tusks.

In Zimbabwe, elephants are considered a valuable resource, for tourism as well as ivory. There is effective anti-poaching protection in several reserves and Zimbabwean game scouts have killed a number of raiding Zambian poachers. The minimum prison term for those convicted of the illegal killing of elephants is five years.

A number of projects researching elephant biology and behaviour have taken place in recent years. The air force assists with spotting elephants in the Sebungwe park, where radio tracking has been going on for more than a decade.

National policy is now to prevent elephant over-population. The total herd has been culled to reduce numbers to about 33 000 (from some 55 000 in 1981).

The role of ivory

It is now clear that most elephants are killed not for their meat but their ivory. Poaching for ivory is almost certainly the greatest short-term danger to the African elephant.

Elephants have been hunted for thousands of years but only recently, with the advent of better roads and automatic rifles, have the numbers killed been large enought to threaten elephant populations over very large areas. Rapid rises in the price of ivory have aggravated the problem.

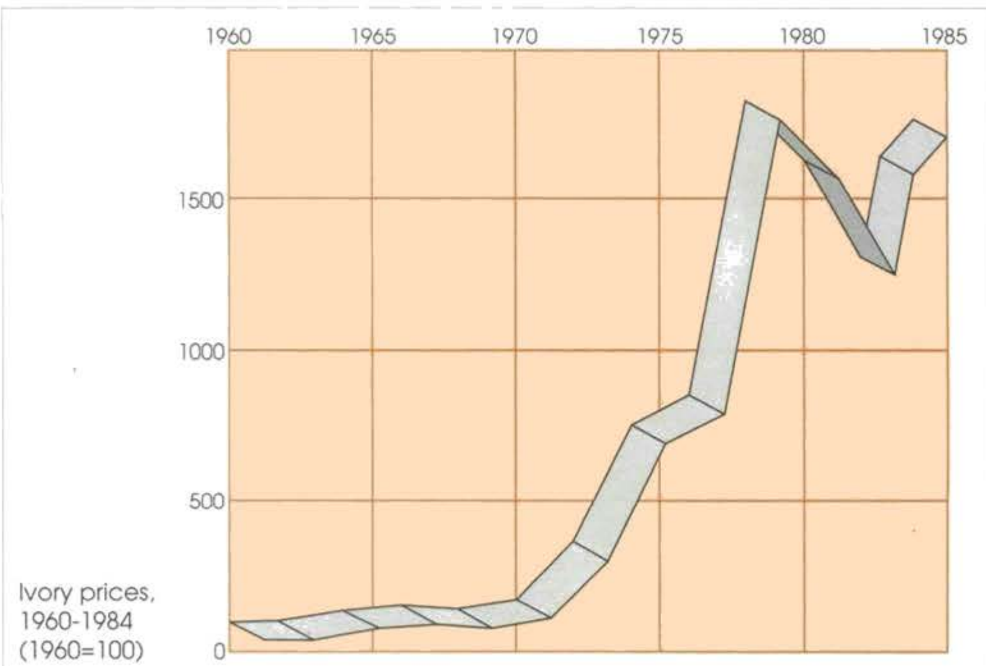
In the 1960s, ivory prices kept broadly in line with inflation. But between 1968 and 1978, prices climbed steeply from $5 to more than $70/kg. By 1982, there had been a fall to $50, but prices were still high enough to persuade whole villages to abandon farming and take up elephant poaching instead. Since then prices have risen even further, reaching $150/kg.

Widespread availability of automatic rifles has also encouraged poaching. Traditional elephant hunting on foot with spears presents considerable risks to the hunter. Hunters using old-fashioned bolt action rifles could selectively shoot only a few large tuskers from a herd before the others fled. Automatic rifles allow whole herds—including young animals with little or no ivory—to be killed easily without skilled marksmanship.

The availability of automatic weapons relates directly to the arms race, civil strife and war. During 1971-1980, Africa's arms imports increased from $500 million to $4.5 billion. General military expenditure increased by 6.6 percent annually and the armed forces in East Africa alone increased from 141 000 to 441 000.

One result was that automatic rifles became widely available in several areas of the continent. Inevitably, many weapons found their way into the hands of poachers. Not only have deserting soldiers sold or

Ivory prices increased sharply during the period 1970-78, paralleling the similarly sharp increase of arms imports over the same



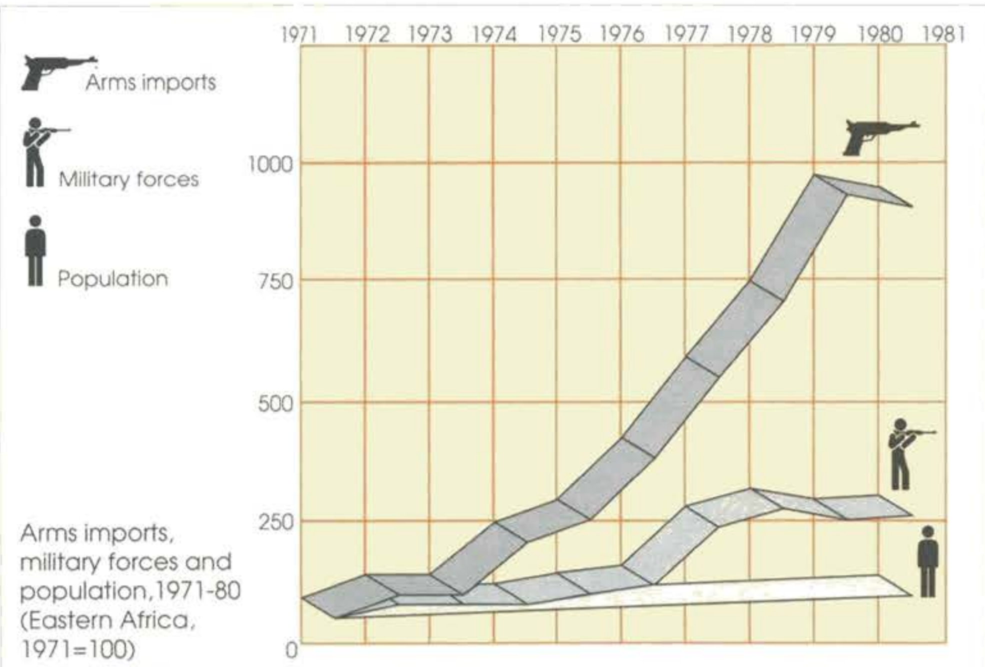
abandoned them, or themselves turned into poachers, but in some countries government officials have also become involved in supplying weapons for poaching.

Since the abrupt price increase in the 1970s, ivory has taken on the role of a new form of currency. Many African countries have strict foreign exchange laws due to their difficult economic positions. Ivory smuggling is one means by which the rich can export their assets from a country illegally.

In the 1970s Sudan's ivory exports were trivially small. By 1981, they exceeded a quarter of Africa's total, much of them thought to be coming from the Central African Republic and Zaire. D. Parry reported in 1983 that Sudanese hunters were crossing the borders in groups of up to 60, armed with Kalashnikovs and G3 automatic rifles, and travelling by horseback and camel. In 1984, Günter Merz commented that ivory was being used as currency to buy automatic weapons, and as a means of rapidly accumulating wealth, despite an official ban on ivory exports. A more extreme case is that of Burundi, which was exporting 12 tonnes of ivory a month in 1983, yet only had one elephant—in a zoo. Most was thought to be coming from Zaire and Tanzania.

In Gabon, by contrast—the richest country in sub-Saharan Africa until 1985—there is still no evidence of heavy organized poaching. Firearms are strictly controlled in Gabon, and elephant populations are relatively stable.

Poaching methods do not depend entirely on automatic weapons, though. A diverse range of modern and traditional techniques is available to the poacher. Poisoned bait papayas filled with battery acid or insecticide are left where elephants will find them. Nailed boards are set into



During 1971-1980, East Africa's armed forces and arms imports increased much faster than the average annual 4 percent increase in population. Elephant poaching increases with the availability of automatic weapons, a by-product of the arms race, war and civil strife elephant paths to immobilize the elephants until the hunters can find them and finish them off with guns or spears.

Better communications and transport have also made poaching easier. In the Selous game reserve in Tanzania, poaching was already on the increase by 1981. The observed ratio of dead to live elephants was rising, and most of the skeletons were found along access routes and close to settled areas. The Shell oil company then built a number of roads in the previously isolated reserve as part of its oil-prospecting programme. Its operations also brought in a labour force that was not averse to poaching. Since the new roads were built, there has been a rapid decline in elephant numbers. The increase in signs of poachers spotted by the rangers, and the numbers of dead elephants seen over the years 1981-1984, are closely correlated.

Until a few years ago, there was considerable dissent as to whether the major cause of declining elephant populations was poaching or competition from human populations for the elephants' preferred habitat. Ian Parker argued forcefully that poaching was not the primary threat, and that conservationists were ignorant of the interaction between local people and wildlife populations. He favoured forms of legalized 'poaching' as the best hope for elephant survival.

By the mid-1980s, however, it seemed

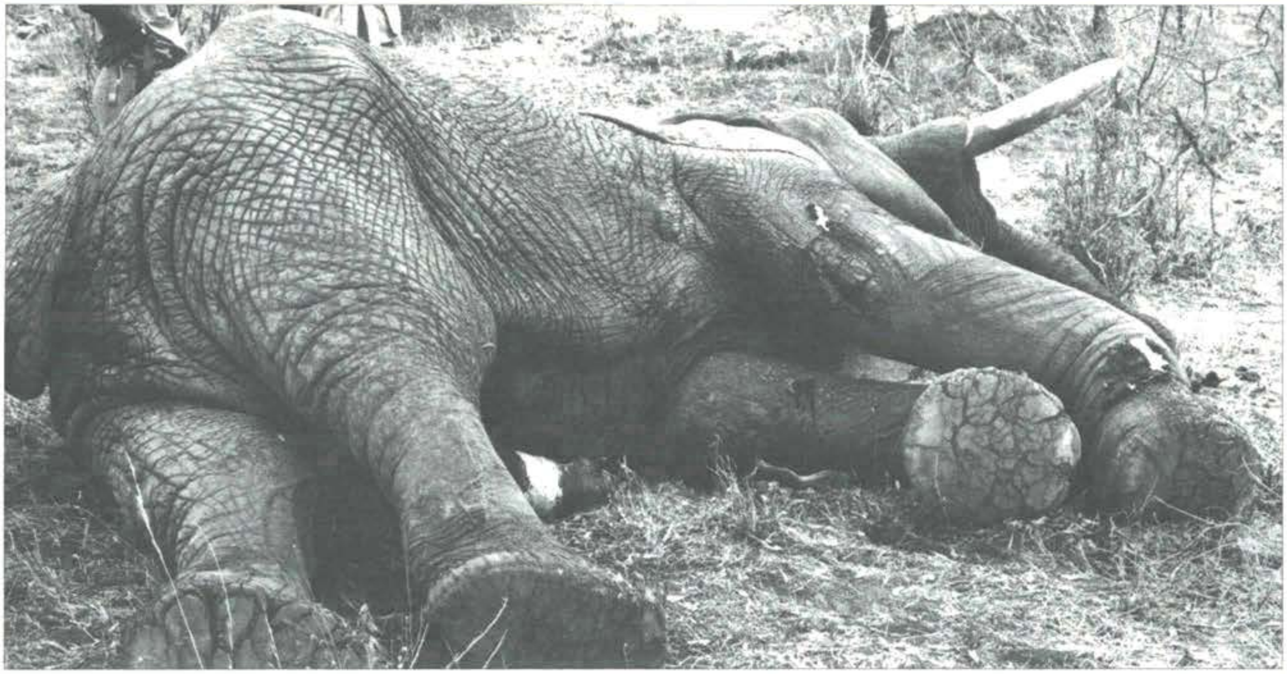
> "It is a pity that an intelligent creature like the elephant should be shot in order that creatures not much more intelligent may play billiards with balls made from their teeth"
>
> Captain Richard Meinertzhagen, *Kenyan Diary*, 1903

Ivory carving

Ivory is carved both inside and outside Africa, but notably in Hong Kong, Japan and a number of centres in the Middle East. The craft is millennia old, and the products of skilled carvers command extremely high prices, particularly in the Far East.

Ivory carvers greatly prefer large tusks from which to work, and will pay much higher per kilo prices for large pieces than for small. This puts a premium on the poaching of mature animals, with the inevitable result that animals of reproductive age are selectively removed from elephant populations. As populations dwindle, however, large tusks become increasingly hard to find, and many smaller tusks have been entering the market since the early 1980s.

The carving industry in Africa is not as highly developed as elsewhere, though it has grown substantially since the early 1970s. By the mid-1980s in Zimbabwe, for example, the annual retail value of ivory commodities was about $8 million. However, there are relatively few skilled African ivory carvers, and—apart from replicas of wild game—most African products take the form of relatively simple napkin rings, candlesticks, bangles and belt buckles. Much of the finely carved ivory on sale in Africa is still imported from the Far East.



clear that whatever the long-term problem, the immediate issue was poaching for ivory, and that the immediate issue was also extremely critical. In 1985, a resolution was passed at CITES calling for the introduction of a system of national export quotas for African ivory. The system came into force the following year, and African countries were then faced with the problem of how to estimate what their sustainable production of ivory might be.

Although previous attempts had been made to draw a continent-wide picture of the state of the African elephant, the reliable data covered only limited areas of the total range, and were of variable quality. This was the background that led UNEP's Global Environment Monitoring System to establish a computerized data base on African elephant populations that could be continuously upgraded as new information was produced.

A poisoned arrowhead is imbedded in the foreleg of this bull elephant in the Tsavo National Park, Kenya —a victim of the traditional poaching methods that are still widely practised

Carved ivory products, such as this delicate Far East sculpture, can command prices running into thousands of dollars

Counting elephants

The first surveys

What can African countries do to halt the potentially disastrous decline in numbers that is occurring? National decision makers are faced with difficult issues and inadequate data—few countries have any accurate idea of how many elephants they have, how their numbers are changing or where they are to be found. Intelligent management is not easy in the face of such ignorance.

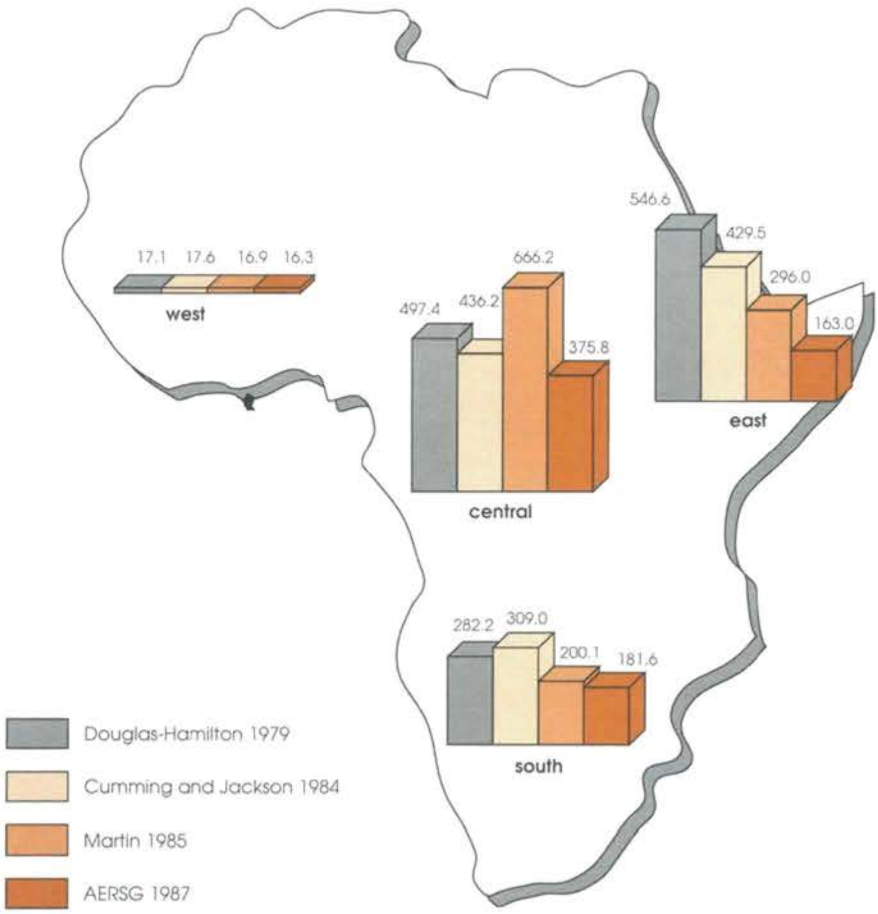
Estimating elephant populations is both costly and difficult. The quickest technique for surveying large areas is the aerial survey. However, aerial survey estimates depend on the width of the strip of land surveyed, and counts of sample areas tend to give higher figures than counts of total areas. Aerial surveys are therefore subject to considerable bias; hence spot surveys on foot should be carried out in selected areas to establish 'ground truth'.

Ground surveys are the most accurate but are time consuming and can cover only limited areas. All too often the only 'data' that are available are the result of intelligent guesswork—observations by local people as to whether elephants are becoming more or less common. Informed guesses tend to provide lower estimates. At one time game wardens in the Selous game reserve in Tanzania estimated that there were 50 000 elephants in the reserve, whereas a sample aerial survey suggested the figure was 109 000.

The problem is even more severe over that portion of the range of the African elephant—some 1.75 million km^2—that is covered by tropical rain forest. Here the elephant can rarely be seen either from the ground or from the air. Solutions that rely on indirect techniques—such as counting the frequency of elephant droppings or elephant pathways currently in use—are being developed but have not been widely applied. Not surprisingly, no surveys of any kind have been carried out over large

Aerial surveys, such as this one over a game reserve in Kenya, are one of the more accurate methods of estimating elephant populations—but even here accuracy depends on factors such as visual acuity, accurate navigation and density of sampling

Results of elephant surveys 1979-87 (numbers in thousands)



Four continent-wide surveys were carried out during 1979-87. Some of the differences between them reflect real trends, as in East Africa, others the correction of faulty information. Authors of the surveys were Douglas-Hamilton (1979), Cumming and Jackson (1984), Martin (1985) and the African Elephant and Rhino Specialist Group (AERSG, 1987)

tracts of Africa's tropical forest, where elephant densities are known to vary widely.

The first attempt to estimate the continent's population dates from 1976 when an African Elephant Survey and Conservation programme distributed questionnaires to experts across Africa, carried out surveys and compiled all available information about numbers, range and trends. This survey, under the chairmanship of Iain Douglas-Hamilton, documented a decline in elephant populations in most African countries in the 1970s. The survey concluded that there were at least 1.3 million animals. At the time, several critics argued that the real total could be as high as three million because no one had any real idea of how many elephant there might be in the forests of the Zaire basin.

David Cumming and P. Jackson reviewed the figures in 1981 and came up with a similar figure, 1.19 million. Four years later, Rowan Martin produced a report for the CITES secretariat with an estimated total of 1.18 million elephants. This estimate differed from previous ones in that it estimated higher forest populations and lower non-forest populations. For example, it included more than 500 000 animals in Zaire; the forest populations were estimated on the basis of several assumptions that were far from universally accepted.

Since then, the African Elephant and Rhino Specialist Group has made a number of attempts to keep track of the situation. Its latest attempt to do so was reviewed at a meeting in Nyeri, Kenya, in 1987, when it produced the startlingly low estimate of 750 000 animals.

A year previously UNEP's Global Environment Monitoring System had agreed to assemble and analyse all the available elephant data. Although CITES had centralized information on ivory movements, there was then no equivalent data base for elephant populations. GEMS had earlier developed its Global Resource Information Database (GRID, *see box*), and this seemed an ideal tool with which to analyse the existing data. In fact, the success of the project has depended almost entirely on the unique collections of data and computer-assisted techniques that are available in GRID. GRID's Geographic Information System (GIS) was used to investigate the spatial relationships that exist between elephant density and other variables such as rainfall and human population density; this, in turn, provided a means of estimating elephant densities in areas for which no survey data existed. GEMS therefore set up the African Elephant Database project, with financial support from the World-Wide Fund for Nature and the Elsa Wild Animal Appeal.

The uses of GRID

UNEP's environmental data base GRID (Global Resource Information Database, part of the Global Environment Monitoring System) contains data sets that have been gathered by different organizations from all over the world. It includes information on such environmental parameters as soil types, vegetation classes, temperatures, rainfall, protected areas and endangered species as well as key background information on national boundaries, population densities and other socio-economic variables.

The information is stored on computers by reference to its geographic location, and the system is therefore known as a Geographic Information System (GIS).

The data are stored in readily accessible forms that make it easy to compare one set of data with another. Thanks to GRID's sophisticated software, it is relatively simple for a GRID operator to ask the system for a map of locations in central Africa, for example, that have specific types of vegetation, rainfall, proximity to large towns and are above a certain elevation.

GRID's power as an analytical tool is that it makes it possible to lay different data sets on top of one another, and to extract whatever information is required.

The GRID study

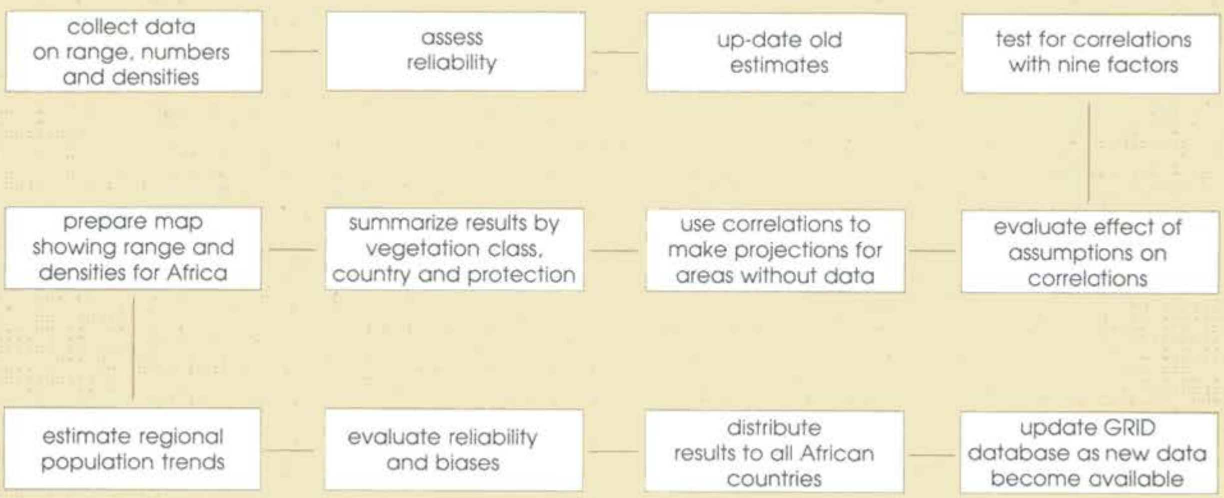
One of the aims of the GRID elephant project was to help African countries revise and set quotas for ivory exports. In 1985, parties to the Convention on International Trade in Endangered Species (CITES) had met in Buenos Aires, and recommended a new quota system for limiting ivory exports. The existing export levels were widely regarded as unsustainable in Africa except in those few countries that had successful management and conservation programmes. The GEMS study is designed to provide the basic data needed to set quotas at sustainable levels.

The overall scheme of the project is shown in the flow chart below. The basic problem is that the available data cover only a third of the area over which the African elephant roams. The study therefore set out to isolate and quantify the factors that influence elephant densities in Africa, and hence arrive at methods of making projections for areas in which there are no census data (*see* Anne Burrill and Iain Douglas-Hamilton, *African Elephant Database Project: Final Report Phase One*, Nairobi, UNEP 1987).

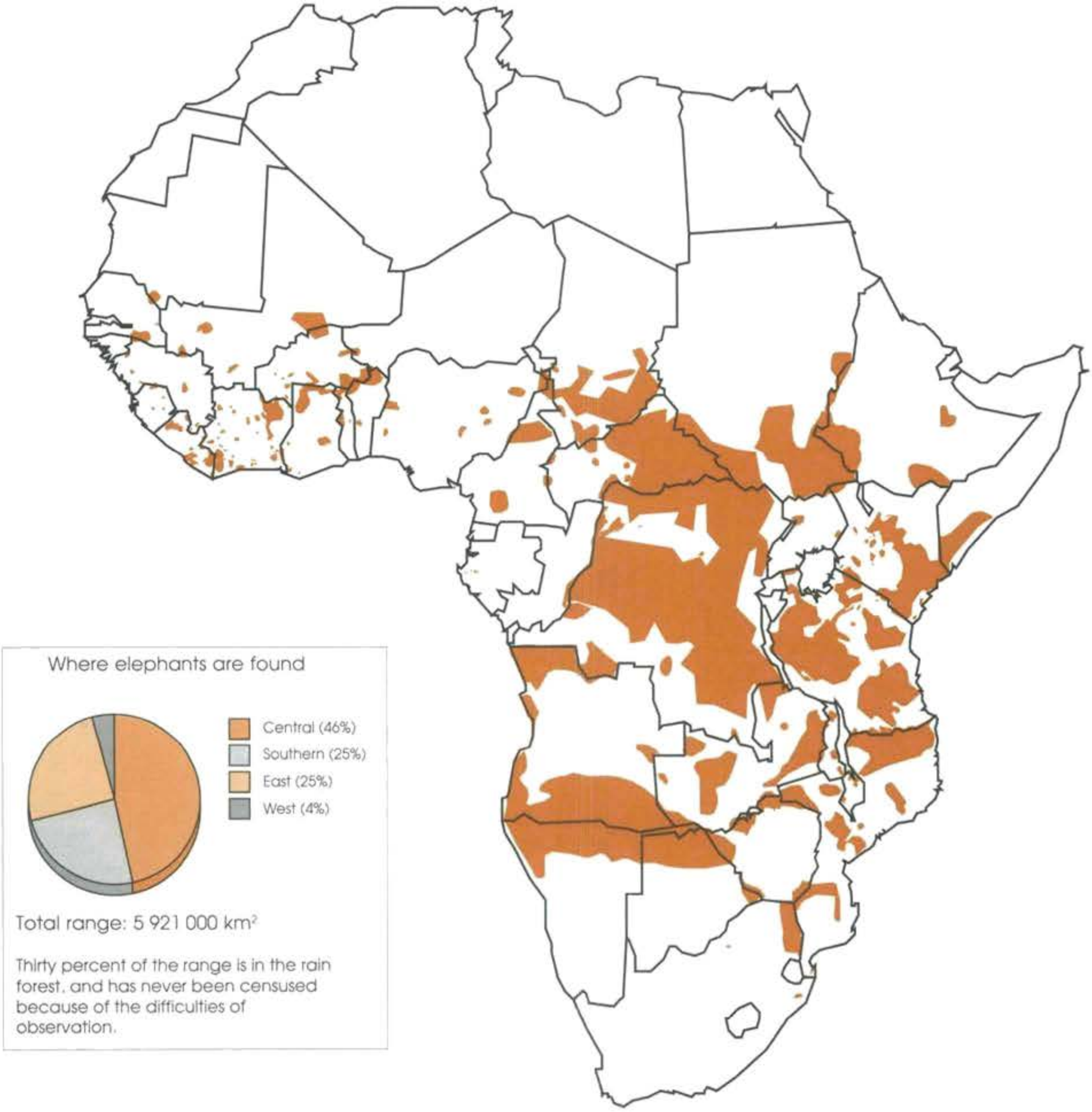
The first step was to establish the elephant's range (*see map on next page*). An existing map of the African elephant's range was reviewed by experts at a meeting in Kenya in May 1987. The meeting also reviewed the data that the project had collected on elephant numbers and density—some 295 collections of data from individuals and organizations, obtained by a variety of techniques ranging from aerial monitoring to game wardens' informed guesses. These data covered 1 939 400 km^2 out of the total range area of 5 921 000 km^2—roughly a third. The number of elephants living in the area for which data were available was thought to be 347 000.

The reliability of each data item was then assessed on a 1-3 scale. Generally,

How the study was organized



The range of the African elephant



Basic data on the range of the African elephant were assembled by the GRID project after consultations with experts throughout the region. The resulting map contains the best information available in May 1987 about the extent of the African elephant these numbers reflected the method of estimation, with highest reliability (score of 1) being given to aerial surveys and lowest (score of 3) going to informed guesses. This information was later used in developing different models for making projections of elephant numbers and densities in areas for which no data existed. Because many of the estimates were out of date, a few by as much as 10-15 years, old information was also adjusted to take into account recent population trends in similar nearby areas. The reliability of these estimates were obviously affected by this updating, and so their reliability scores were then reduced.

Biases in studies of this kind are critically important to the accuracy of the results produced. In this respect, the GRID study is unlikely to have produced information that is intrinsically more accurate than that supplied by other techniques. Indeed, the results clearly suffer from a number of biases, the most important of which is a tendency to over-estimate.

One cause of this is that the extent of the range of areas where elephants are found is thought to be have been over-estimated. Another source of error is that elephants are assumed to be evenly distributed over each sample area, which is rarely the case in reality. The most important bias, however, is probably that the data did not come from randomly selected areas. The areas for which data were available have been those in which elephant populations are known to be relatively high. Extrapolation from these figures to areas where no information was available would tend to inflate estimates. Several methods of correcting this bias were investigated but none was found to be entirely satisfactory.

This problem was particularly acute in Central Africa where figures were available only for parts of Gabon and the Central African Republic, both areas where there are high elephant densities. Using these data as a basis from which to calculate other Central African elephant populations is thought to have caused a substantial over-estimate of numbers in the region.

The point of the study, however, is not so much to produce definitive figures now as to prepare a computerized database that can be continually upgraded and improved whenever new information becomes available. This much has been achieved; indeed, since publication of the first results of the study, new data have been added to the data base, and new tests been carried out for factors that influence elephant densities.

Searching for the correlations

The next step was to over-lay the data on elephant densities and range with other data sets that might be correlated with elephant numbers. Amongst the factors which were thought to affect elephant numbers were poaching levels, human population density, the proliferation of fire arms, and the political stability of the area. In the event, poaching levels had to be excluded from the study because they were known accurately in only very few areas. However, the inclusion of data on protected areas—where poaching levels are much reduced—in conjunction with other factors such as levels of gross domestic product (GDP) went some way to covering this necessary omission.

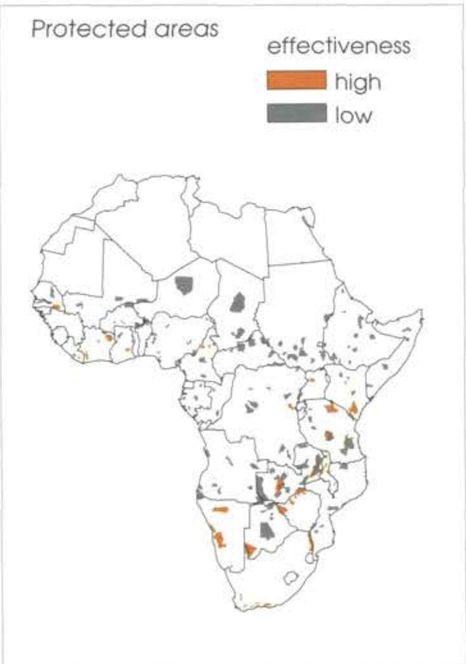
The relationships of nine factors to elephant densities were investigated: protected areas, the presence of tsetse flies, vegetation class, human population density, average annual rainfall, GDP per person, GDP growth rates, the stability of military forces, and the number of years of armed conflict between 1945 and 1982.

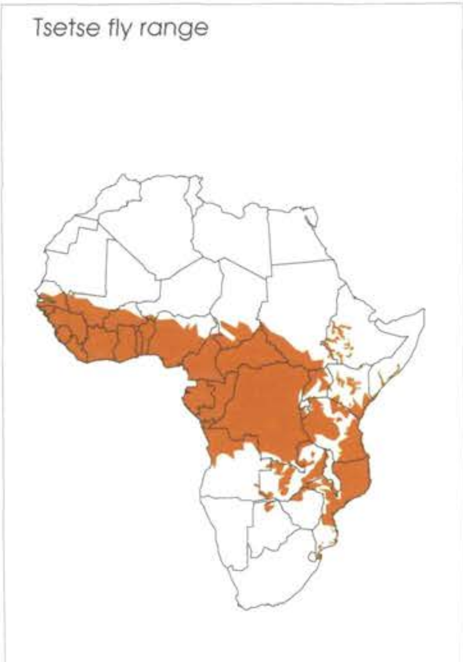
The over-lay was performed using the GRID computer. The information was geographically identified in 4 755 separate areas in the elephant range area, each of which was assigned attributes indicating the degree of protection, the presence of tsetse fly, vegetation class, human density, rainfall, GDP per person, level of economic growth, the stability of military forces, number of years of armed conflict, elephant density, and the reliability of the density estimate.

The data for protected areas were based on a continental map prepared by J. and K. MacKinnon. In some places this map did not show enough detail, so these areas were re-entered from large-scale maps. The estimated effectiveness of the protected areas was also entered, on a scale of 1-4.

The presence of the tsetse fly was thought

Basic data on elephant densities and range areas were over-layed with nine different data sets to search for correlations. Parts of the data sets for protected areas, tsetse fly, vegetation and human density are shown on this and the facing page. The remaining five data sets are illustrated on pages 26-27

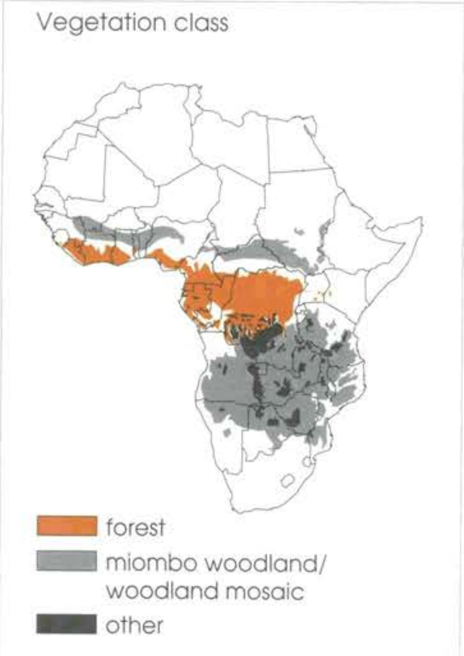


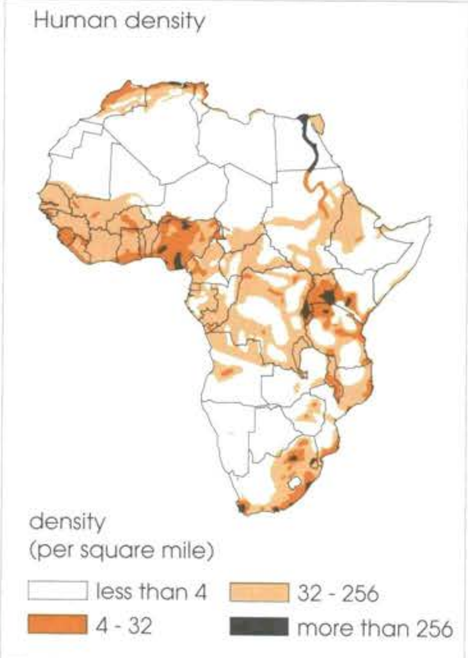


to be relevant because the tsetse affects not only human health—it is the carrier of the parasite that causes sleeping sickness—but also affects cattle populations so severely that livestock production is often impossible in tsetse-infected areas. The elephant, however, is not susceptible to the parasites carried by the tsetse fly. Areas where tsetse flies breed are certainly not the preferred habitat for human populations and should therefore make good potential elephant habitats. The data used came from the Inter-African Bureau of Animal Research, a branch of the Organization of African Unity. Only the presence or absence of flies was entered, not the species, as at this stage it was not thought relevant.

White's vegetation map was used to investigate correlation with vegetation types. This map has a classification of vegetation classes which was too detailed for use with the available elephant information. White's categories were therefore combined to give 15 broad classes, each of which was analysed for correlation with elephant densities. Statistical analysis showed that the classification should be reduced further to three general categories: forest, miombo woodland (*Brachystegia*), and grassland. If other vegetation factors are significant, they did not show up in the study. For instance, it is believed that elephant densities differ in swamp forest and in non-swamp forest. The study was unable to establish this because less than one percent of the data came from swamp forest.

Information on human population density for most parts of Africa is largely out of date, or available only for whole countries. Greater detail was required for this study, because human distribution varies widely within countries, and it is local concentrations of populations that need to be analysed. The only map





showing detailed gradients of human density across the entire continent dates from the late 1960s. Use of such old data was accepted because it is the relative levels of human populations, rather than the actual numbers, that are important, and these have not changed a great deal. Although more recent data would be preferable, past human distributions are probably very relevant to present elephant distributions.

UNEP and FAO had already produced a GRID data set for African rainfall, and this was easily incorporated into the study. It was originally digitized for the GRID GIS by the Environmental Systems Research Institute in Redlands, California.

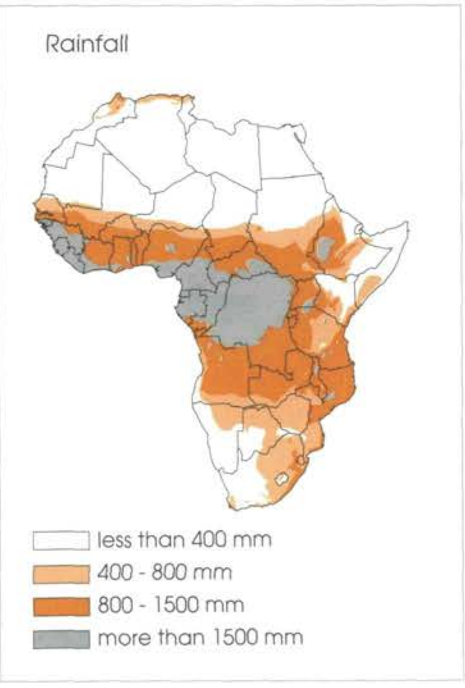
Information on factors such as GDP, economic growth, the stability of military forces and numbers of years of armed conflict are available only on a country by country basis. But, unlike human density, these factors do tend to be defined by national boundaries. Information on GDP and economic growth rates was already included in the GRID data base. Data on the stability of military forces, and on the number of years of armed conflict for each country, were extracted from *The War Atlas* by Michael Kidron and Dan Smith.

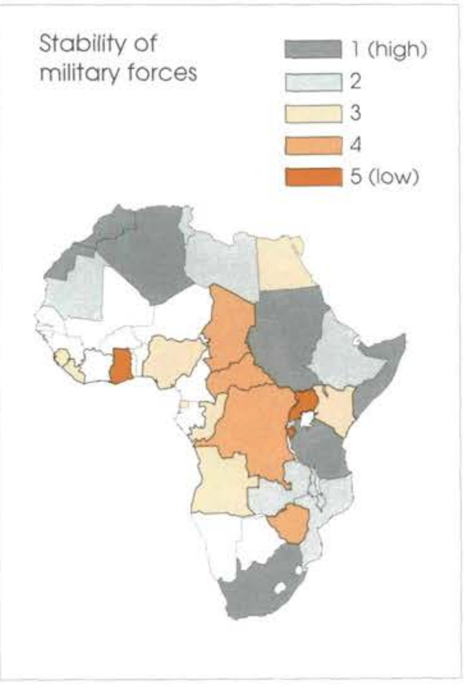
The illustrations on pages 24-27 show the nine data sets that were investigated for correlations with elephant density. Once the over-lay of all the data sets had been completed, statistical analyses were carried out to test for correlations between the nine factors and elephant densities..

The simplest conclusion to emerge was that the number of years of armed conflict during 1945-82 had no significant correlation with elephant density. This factor was therefore excluded from further analysis, and dropped from the study.

The stability of military forces was positively correlated with elephant density, but only weakly, implying that the more

Five remaining data sets—for rainfall, military reliability, GDP per person, economic growth and number of years of armed conflict—are shown on this and the facing page





reliable a nation's military forces, the more likely elephant populations are to thrive.

Rainfall, not surprisingly, is positively correlated with elephant density; considerably more elephants are found in wet areas than in dry ones.

Elephant densities were positively correlated with GDP per person and with economic growth. Surprisingly, they were also positively correlated with high human population densities. There are two possible explanations for this:

- elephants tend to prefer the same kind of habitat as humans; and

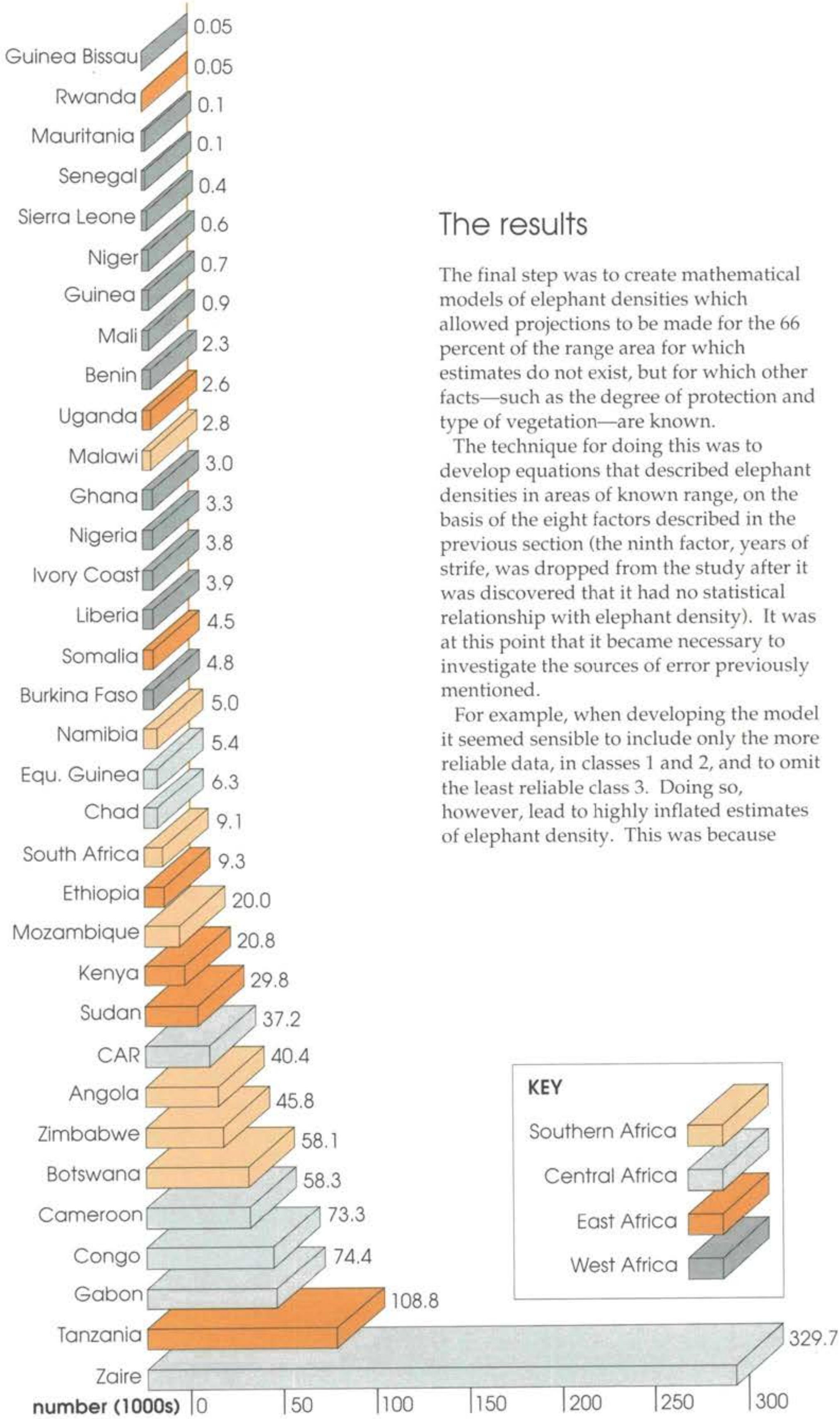
- humans tend to force elephants into limited ranges, particularly in protected areas, as human activities expand, thereby apparently increasing elephant densities.

But these may be only short-term trends. There is plenty of other evidence to suggest that over the long term increasing human populations tend to reduce elephant densities dramatically.

The remaining two factors—the presence of tsetse fly and the degree of protection—were even more highly correlated with elephant density. Of these, the degree of protection stood out as by far the most significant of the factors tested. Protection, in other words, appears to be an effective way of maintaining elephant numbers.

GDP per person, economic growth, and number of years of military strife

country	GDP/person ($)	GDP growth (% p.a.)	years of conflict (1945-82)	country	GDP/person ($)	GDP growth (% p.a.)	years of conflict (1945-82)
Angola	921	-	22	Malawi	210	7.6	8
Benin	230	9.7	2	Mali	187	-	2
Botswana	592	2.1	1	Mauritania	506	-	11
Burkina Faso	164	3.3	-	Mozambique	145	-	14
Burundi	255	5.3	3	Namibia	1076	-5.4	-
Cameroon	826	7.0	8	Niger	259	-0.5	-
Central African Republic	152	-2.4	1	Nigeria	739	-1.0	4
Chad	88	-2.1	18	Rwanda	263	4.1	5
Congo	1083	6.1	4	Senegal	407	-	-
Côte d'Ivoire	691	-3.9	4	Sierra Leone	185	-1.8	-
Equatorial Guinea	205	-	2	Somalia	272	4.5	3
Ethiopia	149	4.3	15	South Africa	2654	4.7	13
Gabon	2955	1.9	1	Sudan	298	-1.0	19
Gambia	245	-	1	Swaziland	960	-0.5	-
Ghana	2550	7.5	1	Tanzania	237	-1.8	6
Guinea	343	3.8	1	Togo	260	-7.9	-
Guinea Bissau	178	-	12	Uganda	n/a	5.8	9
Kenya	291	0.2	9	Zaire	327	-1.8	10
Lesotho	273	1.0	-	Zambia	460	-1.3	5
Liberia	389	2.0	-	Zimbabwe	896	1.0	17



Results of the assessment of current numbers of African elephants are shown in the illustration on the right. The illustration was compiled from data on elephant densities and range using extrapolation to estimate numbers and densities in areas for which no data existed. The figures are subject to a number of biases inherent in the model, and tend to over-estimate actual elephant numbers, particularly in the forested areas of Central Africa

The results

The final step was to create mathematical models of elephant densities which allowed projections to be made for the 66 percent of the range area for which estimates do not exist, but for which other facts—such as the degree of protection and type of vegetation—are known.

The technique for doing this was to develop equations that described elephant densities in areas of known range, on the basis of the eight factors described in the previous section (the ninth factor, years of strife, was dropped from the study after it was discovered that it had no statistical relationship with elephant density). It was at this point that it became necessary to investigate the sources of error previously mentioned.

For example, when developing the model it seemed sensible to include only the more reliable data, in classes 1 and 2, and to omit the least reliable class 3. Doing so, however, lead to highly inflated estimates of elephant density. This was because many of the low-quality estimates came from areas of low elephant density. As already mentioned, one source of error in the study is that much of the original data came from areas of high elephant density. Excluding the low-quality data therefore tends to emphasize this source of error. For this reason, the low-quality data were included in the final analysis.

Once the model had been finalized, three different outputs were produced: the first estimated elephant numbers and density in each of the three main vegetation regions; the second provided data on numbers and density by country and by each of the 15 vegetation classes originally used; and the third was a map of Africa showing elephant densities within the range areas depicted in the map on page 22.

One of the results of the study—the estimate of elephant populations by country—is shown in the illustration on the facing page.

Although the results are certainly far from precise, they represent the best effort yet at a continent-wide census of the African elephant population. Furthermore, the data are stored in the GRID computer, and can be constantly updated to give a more precise picture as new information becomes available. This will apply not only to future elephant surveys but also to the availability of new GRID data sets. It should be possible eventually to assess the relationship between elephant density and land-use patterns, for example. At the time of the original project, this data set was not available on GRID. As soon as it—or any other relevant data—become available the study can be re-run, and the estimates revised. In this way it should be possible to move progressively towards an ever-more accurate assessment of the status of the African elephant, on the basis of which decision makers will be able to manage and conserve their elephant populations increasingly effectively.

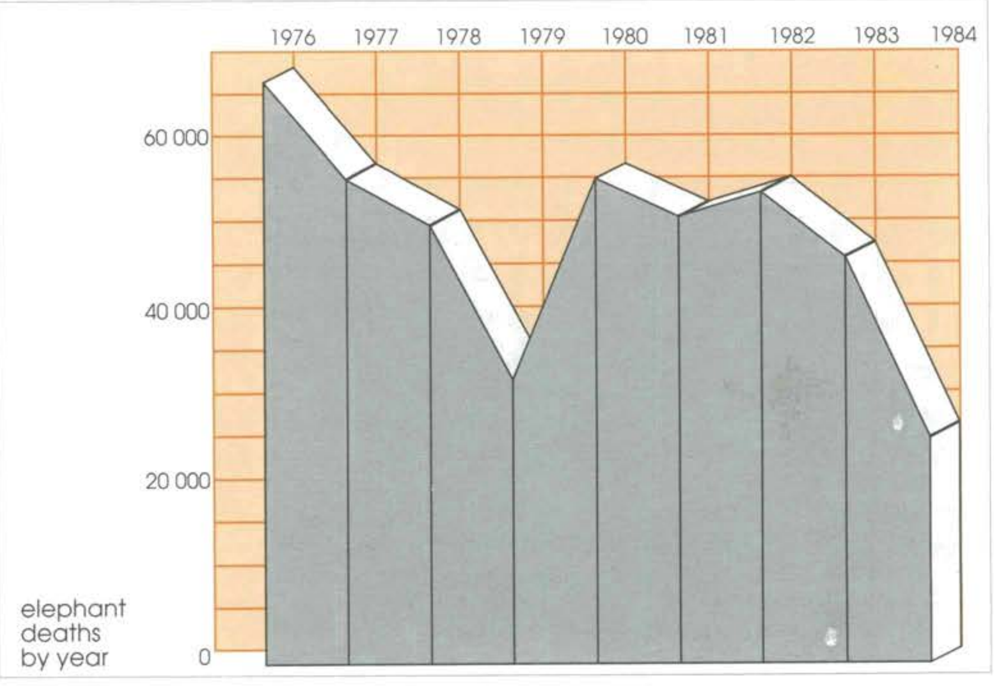
Modelling elephant populations

Any real understanding of what is happening to the African elephant depends critically on several factors: the size of the population, its rate of reproduction, its natural mortality rates, and the number and age of the elephants that are slaughtered, both legally and illegally. Were all these data available accurately, it would be a simple matter to model the population dynamics of the elephant, and predict the ultimate fate of the population without intervention. Management policies could then be devised to balance conflicting requirements such as the tourist industry's need for live elephants, and the ivory industry's for dead elephants.

Before the GRID study, estimates of the total population varied from about 700 000 to 1.3 million African elephants. One way to cross check these figures is to work backwards from what can be deduced about elephant deaths by means of the volume of ivory that enters world trade every year *(see illustration below)*. From these data, it is clear that the elephant population cannot be more than 1.3 million; if it were, and even if the natural rate of population increase were as low as 3 percent a year, then the rate of hunting implied by the ivory trade would still allow overall populations to increase—which is clearly not happening. On the other hand, the lower limit implied by the ivory data is about 800 000 animals; such a population, with a 5 percent natural growth rate, would be reduced by 1.6 percent a year as a result of current rates of hunting.

The figures in the illustration below represent an ivory trade of between about 350 and 950 tonnes a year. Population studies suggest that maximum sustainable ivory production is, in fact, produced by taking tusks only from animals that die naturally once the population has reached its carrying capacity and is in a stable

Ivory trade data make it possible to estimate numbers of elephant deaths per year. The figures shown right are equivalent to an annual trade of between 350 and 950 tonnes of ivory



condition—a situation never likely to occur in Africa. However, a sustained harvest of about 750 tonnes a year could be taken from a population of 1 million animals by careful management.

Large tusks are at a premium in the ivory trade, and selective hunting for the largest tusks reduces the sustainable yield to about 400 tonnes a year. If harvests are increased above this level—as they currently undoubtedly are—population studies suggest that the consequences could be dramatic. For example, if there were a population of 1 million animals growing naturally at 5 percent a year, which was then subjected to an annual ivory harvest of 750 tonnes, the population would continue to grow for a further 22 years, to peak at just under 1.5 million animals. It would then undergo rapid attrition, falling back to 1 million in 14 years, and crashing just 7 years later.

Population trends

Elephant numbers are falling fast across most of the African continent, except for a few areas where poaching is kept under control.

Although the data available on populations trends are not sufficiently complete for GIS modelling, the GRID project compiled a number of regional trends from past data and thus built up a picture for East Africa and parts of Southern Africa.

In Southern Africa, there is a marked difference between countries where poaching is under control (Botswana, Malawi, Namibia, South Africa and Zimbabwe) and those where elephants have little protection. Overall, protected populations are virtually static, with a regional trend of +0.7 percent annually. Information on unprotected areas is patchy but suggests a fall of -8.1 percent a year.

The overall trend for East Africa is also –8.1 percent annually. Almost half this trend represents populations in the Selous National Park, Tanzania, where total elephant numbers have now fallen to about 55 000 from about twice that level in 1986.

Some East African countries have protected areas where populations are stable or increasing, but most of the increases are thought to result from elephants moving into National Parks and Game Reserves to escape poachers elsewhere.

Eastern Kenya has suffered particularly badly, with annual falls of up to 21 percent in some regions. Over the past 15 years, several districts have lost 90-95 percent of their elephants. Calculations for the Sudan show a decrease of 77 percent over the period 1977-87.

The East African trend data indicate that protected populations will halve every ten years, and unprotected ones every five years. These estimates assume that the numbers of elephants killed will decrease as elephants become more scarce. But were the rate of killing to be maintained at the level of the past ten years, 14 500 elephants would be killed each year in East Africa until the elephants become extinct there in 1995. Such a scenario is unlikely but, unless the factors causing elephant decline change, the rate of decrease will probably lie somewhere between the two models.

Figures for the northern non-forest areas, in a band from Somalia to Senegal, are very fragmented. The average fall in this region is about 17 percent annually, which fits in reasonably well with reports of very heavy poaching in this northern savannah zone.

Few reliable scientific data are available in the Central African rain forest but the existing information was summarized by Richard Barnes. "There are now large areas of forest in Cameroon, Congo and Zaire where elephants are no longer found", he writes. "Nearly all the accounts either state explicitly or imply that ivory is the reason elephants are being killed."

Habitat loss through human settlement is not an important factor in Central Africa except in some parts of Cameroon. Population densities are low, and the crop-raiding elephants shot probably account for only a very small portion of the population.

Barnes points out that commercial timber exploitation benefits forest elephants by creating their favourite habitat, secondary forest. Areas of the rain forest where trees have been felled, or plantations abandoned, quickly sprout new growth. But development also brings in migrant labourers who poach themselves and open up access roads for other poachers to use. Such developments are likely to have an increasing effect on Central African elephant populations.

Kenyan population trends 1977-1987

Unprotected areas

Garissa	-90%
Lamu	-91%
Tana River	-82%
Kilifi	-97%
Kwale	-87%
Isiolo	-88%
Samburu	-68%
Turkana	-66%
Laikipia	-1.0%
Narok	-87%
Average	-77%

Protected areas

Mara GR	55%
Amboseli NP	51%
Meru	-79%
Samburu, Buffalo Springs	19%
Marsabit NR	-41%
Mt Kenya NP	-33%
Mr Elgon NP	-80%
Aberdares NP	-33%
Average	-57%

East African population trends 1977-1987

Kenya	-67%
Tanzania	-53%
Uganda	-56%
Unprotected average	-78%
Protected average	-51%
Average	-57%

Implications for policy

The quota system

A substantial decline in the number of African elephants is to the long-term advantage of no one—whether they be poachers, hunters, ivory traders, artisans carving ivory, game park wardens or conservationists. This was the background that led to the 1985 CITES resolution to set up a system of ivory export quotas, a system that was specifically requested by the African countries themselves.

The quota system, which came into operation in January 1986, establishes a number of new procedures for controlling the international trade in African ivory. The key provision is for each state to establish its own annual quota for the export of ivory. The quotas are set by individual African countries yearly, and CITES has devised a means of estimating sustainable quotas based on such factors as the numbers of animals expected to die, how many of them will have tusks, past stocks, and ivory used domestically. Countries that do not notify CITES to the contrary are deemed to have a zero quota.

States that are parties to CITES (and those that have agreed to comply with CITES control procedures) must prepare valid export documents for each shipment if they wish to export ivory. These documents must specify the country of origin, and the weights and sizes of the tusks being exported. These data are also recorded on the tusks themselves, either by punch or in indelible ink. A copy of the export documentation is sent to the CITES secretariat as soon as it is ready. The Secretariat then informs the importing country of the legality of the expected shipment before it arrives. Countries that are parties to CITES must not accept ivory imports without the correct documentation.

A copy of the export documentation is also forwarded to the Wildlife Trade Monitoring Unit (WTMU) of IUCN's Conservation Monitoring Centre in the UK. The WTMU operates a computerized data base on the ivory trade, containing data on each individual tusk. During 1986, the WTMU computerized details of some 700 export permits involving 91 000 tusks, as well as a stock of 52 000 tusks held in Singapore. Deliberate falsification or duplication of tusk numbers can be quickly revealed by the computer programme, and importers can then be advised of the illegality of a shipment before it is cleared through customs.

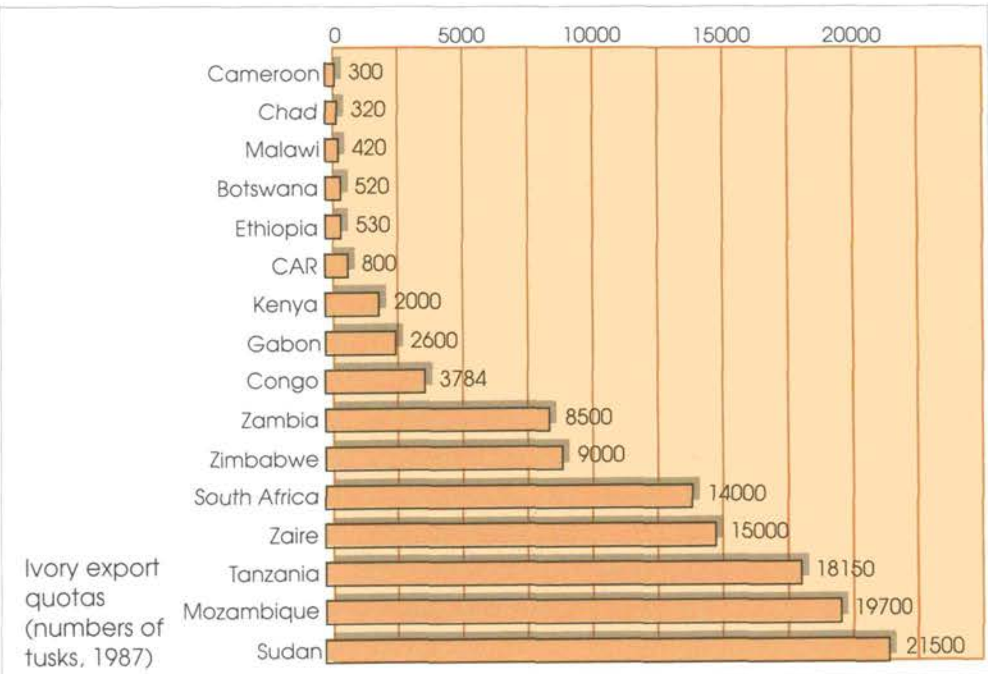
How the ivory trade is changing

How effective is the quota system proving? One of the difficulties in answering this question is that the ivory trade is undergoing profound change for several reasons. Some of these changes were underway before the quota system was conceived, and others were introduced before it became operational, and were in effect designed to reduce its impact.

After World War II, the focus of African ivory exports changed from Europe to Japan and Hong Kong, although much of the market was still auctioned from European trading centres such as Paris, Amsterdam and Brussels. Until the early 1980s, Hong Kong was the effective centre of the ivory trade; but because Hong Kong legislation implemented CITES controls on ivory fully, while Japan did so only partially, this balance changed during 1983/84. This process was actually precipitated by two events: first, Sudan banned all ivory exports at the end of 1983; secondly, Belgium acceeded to CITES in January 1984, and ivory exports to Europe were subsequently more rigorously controlled. This gave Japan, with its ineffective legislation on CITES controls, an edge on other importers. Burundi became the main exporter of ivory to Japan, with the United Arab Emirates, Macau and Singapore being used as staging posts. Burundi has virtually no elephants but has imported substantial quantities of illegal ivory from other African states.

Then, in 1985, came the CITES meeting that set up the quota system and a change in Japanese legislation that required ivory imports to be accompanied by a full ivory export license. This created a block to ivory exports just at the time when traders must have deemed it prudent to move as much ivory out of Africa as possible before the quota system became operational. As a result, large stockpiles began to build up in the staging posts.

Ivory export quotas (right) were set for 17 African producer countries in 1987. Figures for Botswana, the Congo, Malawi, Mozambique, the Sudan and Uganda are largely to clear existing stock



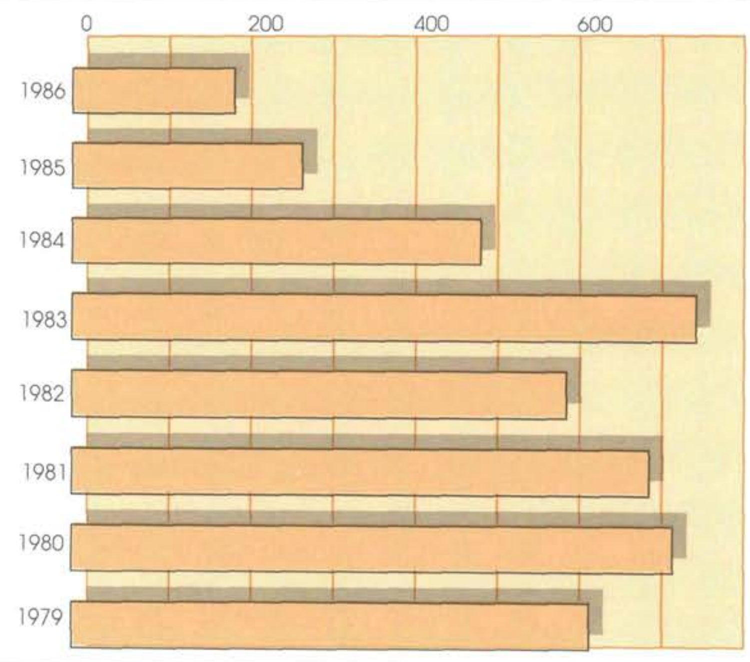
As the quota system became operational, several countries, notably Sudan and Somalia, applied for large quotas to export their existing stocks. Of the African producer countries, 18 applied for quotas in 1986 but they exported only 45 percent—some 41 000 tusks—of the total they applied for. This was partly because traders, with estimated stockpiles of 500 tonnes—worth US$ 50 million—were less than keen to build up yet more stock.

But it was also because much of the trade remained illegal. CITES estimates that in 1986 at least a further 300 tonnes left Africa illegally, much of it from Burundi via the United Arab Emirates for Singapore. Analysis of the stocks registered in Burundi reveals that 40 percent originated in Zaire, 30 percent in Tanzania, 20 percent in Zambia, with the remaining 10 percent coming from Botswana, Kenya, Malawi, Mozambique, the Sudan, Uganda and Zimbabwe.

Thus several events, including the arrival of the quota system, have conspired to produce radical changes in the ivory trade. In 1986, other important events included the enactment of CITES legislation by Macau, and the accession to CITES of Singapore, effectively closing these previously important staging posts to illegal imports.

Unfortunately, as the African Elephant and Rhino Specialist Group reported to CITES in 1987, the victory is more apparent than real. According to the AERSG, legal ivory exports from producer countries accounted for only 22 percent of the number of elephants thought to have been killed; a further 150 000 tusks, in other words, must have entered the trade illegally.

This, in itself, is no reason to despair of the quota system. For one thing, it is the existence of the quota system that now makes it possible to estimate the size of the



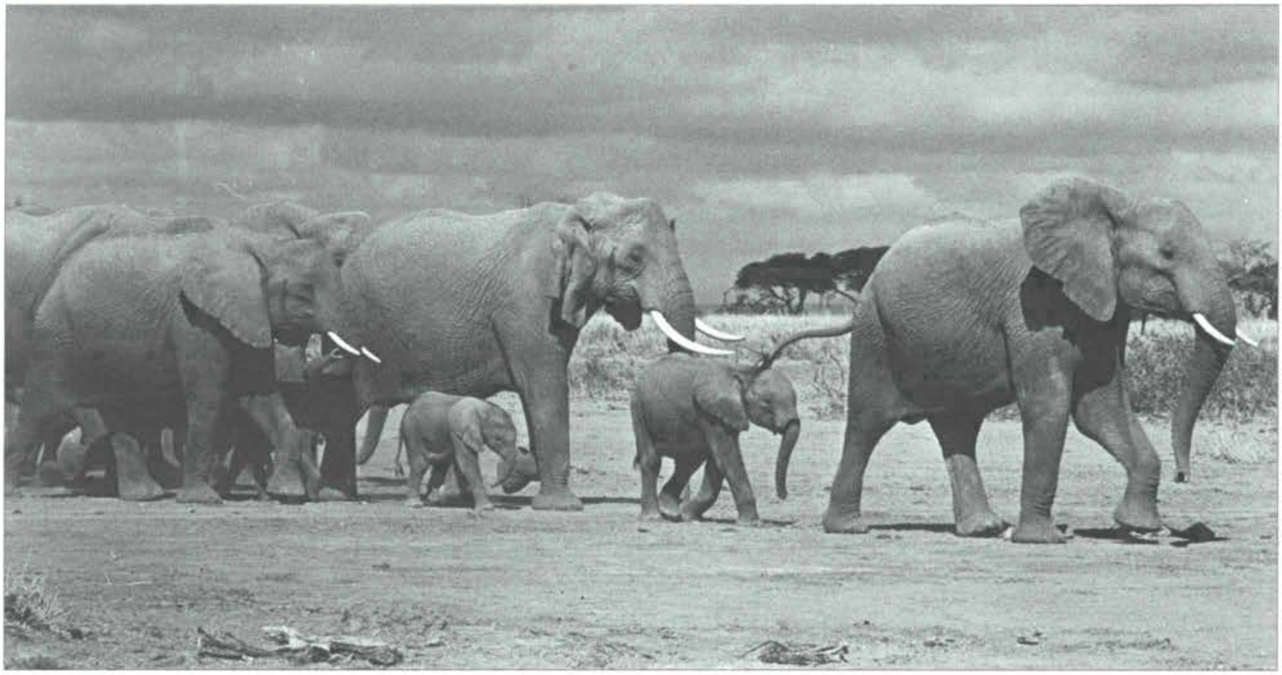
Hong Kong and Japanese ivory imports (tonnes, excluding mutual trade)

Hong Kong and Japanese imports of raw ivory dropped dramatically in 1985 and 1986, partly because Japanese import legislation was tightened up, and because Belgium—an important trading centre for ivory—acceded to CITES

legal and the illegal trade. Secondly, the first two years of the system have been concerned with re-stabilizing the ivory trade, and getting rid of past stocks; future years will reveal more about what is really happening. Thirdly, the existence of the quota system is beginning to produce a two-price market, with legally exported produce commanding much higher prices than illegal ivory. Eventually, this must help persuade poachers that their trade will become less easy and less profitable.

Finally, CITES legislation has been instrumental in revealing some of the illegal trade. In January 1986 Belgian customs officers seized 10 tonnes of ivory in Antwerp, in two containers labelled 'bee-wax'. A further 1.5 tonnes was discovered in a shipment of malachite in Lisbon. And in June 1986 Zambian authorities seized 564 tusks in a concealed compartment of a lorry heading for Burundi. Illegal exports have also been seized in China, Hong Kong, Kenya, Mozambique and Tanzania.

Elephant tusks captured from poachers in Zambia. In June 1986 CITES legislation enabled the Zambian authorities to seize 564 tusks hidden in a concealed compartment of a lorry heading for Burundi



Priorities for the future

When 80 percent of the ivory trade is still illegal, it is too early to judge the effectiveness of the quota system. The alternative—a complete ban on the ivory trade—is unlikely ever to be successful because world-wide investment in the ivory business is too large. A ban on the trade would probably result in the withdrawal from CITES of several African and Asian nations; trade would continue on a wholly illegal basis with the result that no part of the trade could be monitored or controlled.

On the other hand, the quota system is as yet far from effective, if only because many African countries have so little idea of their elephant populations that they cannot possibly set realistic and sustainable ivory quotas. This is particularly true of central African countries with large areas of tropical rain forest. Sample surveys are now being carried out in many forested areas but whether the results can be obtained, run through the GRID computer, and used to alert the authorities quickly enough to avert major catastrophes in these areas, is unclear.

If the quota system is to become really effective in reducing illegal trade, action will also have to be taken in regard to worked ivory. Many countries do not legislate against the import of worked ivory in the same way as they do raw ivory, and CITES controls on worked ivory are less strict than those on raw ivory. Already ivory carvers are being moved to places such as the United Arab Emirates, Dubai and Taiwan—where there are few import controls on even raw ivory—so that the partly worked products can then be freely imported into the major centres. Much of this loophole was, however, removed in 1988 when Hong Kong made the importation of worked ivory illegal.

However, improving the quota system is not the only means available of halting the decline of the African elephant. As the GRID study showed, the factor that correlates most highly with elephant density in Africa is the degree of protection afforded to the elephant. There is no shortage of game reserves and national parks in Africa. However, their management leaves much to be desired. African countries need substantial help to increase the efficiency of their protected areas—to hire and train more staff, to provide them with better equipment, including transport and firepower with which to overwhelm poachers, and to increase the frequency and precision of elephant surveys. Greater effort in this direction would go a long way towards dealing with the current critical problem.

It is important for African nations that the elephant is preserved in substantial

Long term, the future of the African elephant remains in doubt; even if the population eventually recovers from the current high levels of poaching, the relentless expansion of the human population will pose a severe threat unless management and conservation can be greatly improved numbers for future generations. Many rural populations depend on wildlife, including the elephant, for protein and for moderate amounts of cash income. Conservation of the elephant will ultimately improve the lifestyles of many of Africa's rural poor.

The elephant is also a major tourist attraction, and as such represents a source of considerable revenue to many African nations—a revenue that has already been developed in some areas, but is still awaiting development in others. It would be tragic if the animal that best symbolizes the attractions of the African continent were to become extinct—or vanishingly rare—before nations had the chance to capitalize on its existence.

Alarmingly, there are even some indications that this may be happening. In mid-1987, the GRID estimates for elephant populations in the Manyara and Queen Elizabeth National Parks in Tanzania were 430 and 700 respectively. Aerial surveys carried out later in the same year showed that these numbers had been reduced to 181 and 120 respectively. If these two surveys turn out to be typical populations, then the GRID estimates will have been shown to have erred on the side of optimism. The fate of the African elephant will be even more critical than the picture painted in this publication.

With luck, what will now happen in Africa is that more states will begin to manage their elephant populations effectively. But there are indications that even in those areas where gross mis-management continues, and poaching remains effectively unchecked, the elephant is unlikely to become extinct. When elephant densities fall below a certain critical minimum, poaching may well become totally uneconomic. This could be the African elephant's saving grace. The elephant population may then begin a slow, perhaps very slow, recovery.

This possibility is by no means certain. An alternative scenario is that, as ivory becomes rarer, its price increases even further until it reaches a point where it pays poachers to spend weeks tracking down the last remaining elephants and finishing them off. If this were to happen, the elephant population could well nose-dive, rather than begin a slow recovery. In the long run, the problem will require a much deeper and longer-term analysis. Even if poaching could be completely eliminated , the African elephant would still be threatened by human expansion, particularly in those areas where rainfall is high enough to farm crops; elephant farming is not as profitable as crop farming, and is often incompatible with it. The value of elephants for tourism, of course, is substantial but African countries would also have to consider matters to do with the intrinsic value of single species, and of the elephant in particular. Such value-laden decisions will not be easy. The one consolation should be that, by then, thanks to the GRID project and other studies of the African elephant, enough will be known about elephant numbers to make sensible management decisions.

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