SUMMARY FOR POLICYMAKERS

THE NATURE OF THE ISSUE

PRIOR TO European colonisation, elephants occurred virtually everywhere in the area that comprises the modern South Africa, as well as in much of the rest of sub-Saharan Africa. By the beginning of the twentieth century, elephants were in decline over most of their former African range and almost extinct in South Africa. The main causes of the decline were hunting (for ivory, hides, and meat) and loss of habitat, mainly to agriculture. The establishment of protected areas has led to a remarkable recovery in elephant numbers in South Africa, Namibia, Botswana, and Zimbabwe. Elephants remain relatively numerous in Zambia and Mozambique. In most of the rest of Africa, elephant populations are either very low (West Africa), or declined precipitously in the 1970s and 1980s and are now more or less stable (East Africa). The forest-dwelling elephants of Central Africa, almost certainly a different species, continue to decline at an alarming rate. Although the African savanna elephant is not at imminent risk of extinction (figure 1), its population trend has been, and continues to be, of international concern. Actions taken to manage elephant populations in Africa are subject to intense scrutiny and often political pressure. Legal international trade in elephant products is strictly regulated in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to which South Africa is a signatory.

This assessment deals exclusively with the management of near-wild populations of the savanna-dwelling African elephant (*Loxodonta africana*) in South Africa. It does not deal with captive elephants. Information on the elephant populations of southern and East Africa is clearly relevant to this Assessment and has been cited, but the social and ecological conditions under which they occur differ significantly from the circumstances in South Africa. The South African situation, where elephant and human distributions are completely spatially separate, is unique.

The elephant population density (i.e. the number of elephants per square kilometre of current elephant range, for a given period of time) has risen in parts of the southern African states listed above to the point where it raises concerns regarding impacts on the environment and people. The key concerns in South Africa are the appearance and ecological functioning of the landscape, the potential impacts on other species of plants and animals, and the livelihoods and safety of people adjacent to the elephant range. There is a vigorous, and often acrimonious, debate as to whether elephant numbers need to be curbed or reduced in South Africa, and if so, how.

Although elephants have been scientifically studied for over half a century, some of the information that could help to guide appropriate decisions is unavailable to the decision-makers, contested by experts, or simply unknown. The Minister for Environmental Affairs and Tourism, who has ultimate responsibility for elephant management within South Africa, convened a Science Round Table to advise him on the issue. One of the recommendations of the Round Table was that an assessment be carried out to gather, evaluate, and present all the relevant information on the topic. This section of the Assessment is a summary of the longer document entitled 'Scientific Assessment of Elephant Management in South Africa'. The assessment process involved 64 experts as chapter authors, and a further 56 persons, including scientists, policymakers, and stakeholders, in the extensive review process.

WHY ELEPHANTS WARRANT SPECIAL MANAGEMENT

There are three main reasons. First, elephants are the largest of the extant land mammals. They are known, along with rhinoceros, hippopotamus and giraffe, as 'megaherbivores' (plant-eaters weighing more than 1000 kg). Elephants are capable of transforming the ecosystems in which they occur in dramatic ways, for instance by debarking or pushing over large trees. Along with large size come the attributes of longevity (up to 60 years) and a relatively slow population growth rate (a long-term rate of up to 7 per cent per annum), which make elephant populations slow to respond to management or changes in resource availability. Because of their large size, low relative metabolic rate and hindgut digestive system, elephants consume a wide range of plant parts, including grass, herbs, tree and shrub foliage, fruit, woody stems, bark, and roots. Further consequences of a large body size are that elephants have few natural predators and a large home range, now substantially constrained.

Second, elephants have a large and complex brain. They are capable of learning and remembering. They experience fear, pain, and (apparently) a sense of loss. They are inferred to be among the more intelligent animals. Third, elephants exhibit complex social behaviour that includes the lifetime persistence of extended family linkages (figure 2).

While none of these attributes are completely unique to elephants, they exhibit them in combination, and to such a degree, that people of many different cultures and backgrounds agree that elephants must be managed with a degree of respect greater than that afforded to most other species of wild animals.

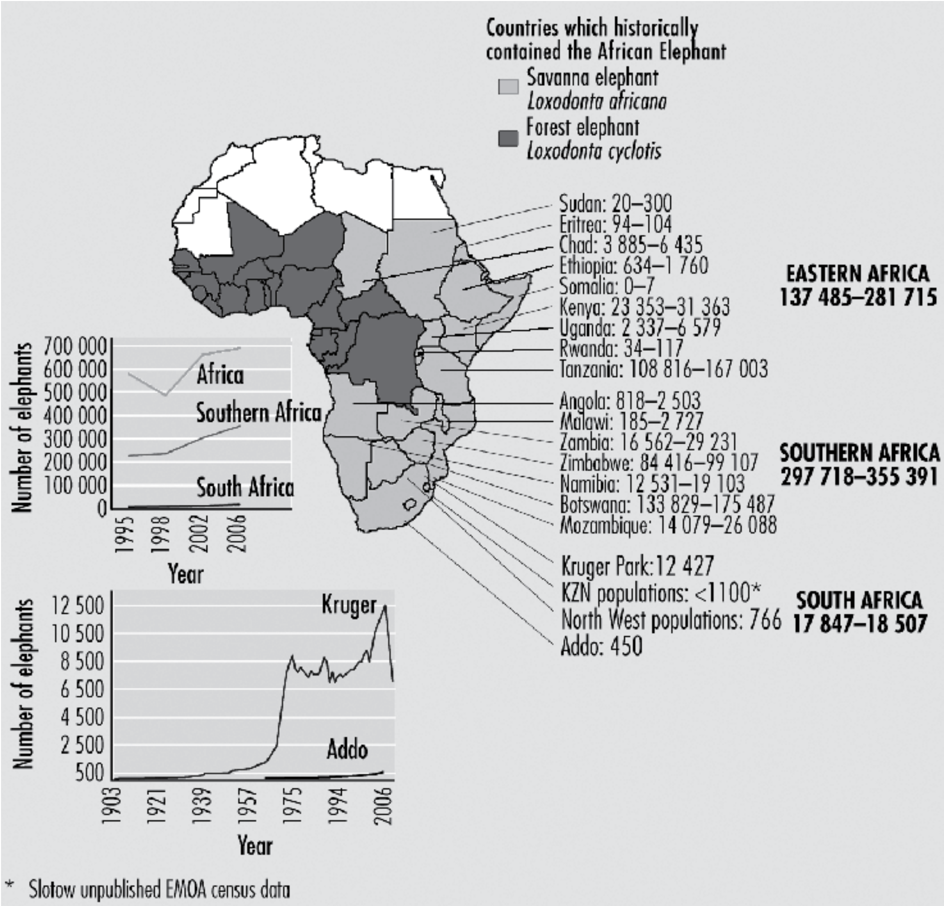

Figure 1: Elephant distribution and population trends in Africa, southern Africa and South Africa. The range in elephant numbers is due to the differences in survey type as defined by Blanc *et al.* (2007), with the first number indicating 'definite' elephant numbers and the second a combination of 'probable', 'possible', and 'speculative'. These categories have decreasing levels of data reliability

HUMAN–ELEPHANT INTERACTIONS

The African elephant and humans both evolved in Africa, where they have a 250 000-year history of cohabitation. For most of that time, humans have been predators of elephants. In the modern period, the interactions between elephants and people take a great variety of forms. Positive interactions include the excitement and awe felt by tourists who look at them. Negative interactions include loss of crops and infrastructure due to elephant damage, infection

Figure 2: The structure of elephant social organisation. The degree of coherence and importance of the 'bond group' and 'clan' levels remains a matter of disagreement among researchers. The 'subpopulation' level is defined by the ability of the groups to exchange genetic information, and is largely determined by geographical separation. It can be maintained or altered by the translocation of breeding individuals between groups

of livestock as a result of elephants having breached veterinary fences, thus allowing the mingling of wildlife and domestic stock, and direct injury or loss of human life. Relative to the incidence of direct human–elephant conflict in other elephant-range countries in Africa, the frequency and severity of such incidents in South Africa is low (amounting on average to fewer than four deaths per year, and a few tens of thousands of rand of crop damage). This is largely because in South Africa people and elephants have been effectively separated by fences. Most of the incidents involving death or injury of humans take place within the protected areas, or under captive conditions. The levels of conflict may escalate as elephant and human population densities rise further, and if palatable crops are planted and fragile infrastructure is constructed adjacent to elephant-containing areas. Even low levels of human–elephant conflict have a negative effect on people's perception of elephants and conservation, if inappropriately handled.

Human values with respect to elephants cannot be classified into a simple preference for protection or consumptive use. For example, some 'consumptive use' groupings, such as recreational hunters, are highly committed to elephant conservation, and some protection-orientated groups see sustainable use as the key to long-term conservation. Furthermore, attitudes towards elephants are constantly changing, as is the relative power between the various groups of interested parties. There are no definitive surveys in South Africa regarding the size of the stakeholder groups, nor a definitive description of the opinions they hold.

THE 'MORAL STANDING' OF ELEPHANTS

This Assessment considered elephant management from several relevant and documented ethical perspectives, including mainstream 'Western', African traditional and animal rights-centred viewpoints. Human intervention in natural processes in general, and in the lives of elephants in particular, is permissible under defined and restricted conditions in all these ethical frameworks. Under certain circumstances interventions may even be ethically required, when non-intervention has consequences that are ethically unacceptable.

There are scientific reasons to suggest that elephants have a higher degree of sentience than the vast majority of other mammal species. Nevertheless, their capacity for self-consciousness, empathy for other elephants, and problem-solving ability is, on the basis of available information, very much lower than that of humans, and it is humans who define the values framework. Ethically, this suggests that in the tradeoffs between elephants and other species, the needs of elephants might receive a somewhat higher weighting than other species (though not to the point where other species are threatened with extinction), but a lower weighting than the needs of people.

The killing of elephants is defensible in terms of all the above ethical frameworks in the case of imminent danger to human life. A strongly ecologically-orientated ethic would also permit culling where there are strong grounds for believing that the persistence of other species is under threat. A human-centred ethic would permit elephants to be killed if human life or livelihoods were threatened, and in some versions, permits elephants to be killed for human use, including sport. Given the plurality of ethical positions on killing elephants, it is a practical necessity in a participatory democracy such as South Africa for non-lethal options to be seriously considered and found lacking before the lethal option is selected.

The level of self-awareness and empathy exhibited by elephants suggests that they might be considered to have a limited form of a 'right to privacy', in other words, they should be harassed as little as possible. Knowingly causing unnecessary suffering to any sentient organism is unacceptable and forbidden by law. In elephants, there is reasonable cause to suggest that suffering includes emotional stress, for instance through fear based on past experience, or through witnessing harm to other elephants, especially those in the same family group.

CONTROLLING THE DISTRIBUTION OF ELEPHANTS

High levels of elephant impact result from the concentration of animals in specific habitats or areas at particular times of the year, rather than the absolute numbers of elephants. Therefore, methods of altering the distribution of elephants in the landscape are an important way of managing impacts. Fencing is the main current option, though behavioural modification holds some promise. Fences can be used to keep elephants inside protected areas, or keep them out of sensitive locations within the protected area. The effectiveness of elephant fencing varies greatly according to its design and location, and so does its cost. Electrified fences costing R120 000 per kilometre to erect, can almost entirely contain elephants (substantially less than one elephant breakout/km/y). More expensive mechanical fencing including high impact cable (e.g., Addo's 50-year old 'Armstrong fence', which is estimated to cost R150 000 per kilometre to erect at current prices) can reduce this to virtually no breakouts – one recorded case in 50 years. The minimum legal requirement for electric fencing designed for elephant control costs R34 000 per km to construct, and is anticipated to reduce breakouts to less than 1 per km per year. Ordinary game or livestock fencing has little control value for elephants.

Fences have a maintenance cost over the lifetime of the fence (which is typically several decades, but differs for the type of fence – electric fences have a shorter lifetime and are more expensive to maintain) of 4 to 8 times the initial cost of the fence (expressed in inflation corrected terms). Nevertheless, the cost of constructing and maintaining elephant-restraining fences is lower than the potential damage costs if the fences are not present or ineffective. The damage costs caused by elephant can be direct, in terms of loss of human life, injury, disruption of livelihoods, loss of crops, and damage to property; or indirect, through allowing other damaging or disease-causing animals in or out of the fence breaks caused by elephants. In the South African context, the indirect costs are the main component of damage, and have added up to tens of millions of rand for individual disease epidemics traceable to fence-breaching usually, but not always, caused by elephants. Averaged over the period 2001–2006, the veterinary costs of containing major foot-and-mouth disease outbreaks due to the mixing of wildlife and domestic livestock works out at R28 500 000 per year (in 2007 values).

Research elsewhere in Africa has shown that elephant movements can also be influenced by non-physical barriers (such as chemical repellents, sound or disturbance, referred to as conditional aversion methods), but the control is partial and often temporary.

Elephant distribution can potentially be altered by the manipulation of water availability. Cow herds with calves need to drink every day, and seldom move more than 16 km from surface water. Bull elephants drink less frequently, and range further than cow-and-calf herds. If areas of at least 40 km diameter could be rendered free of surface water for large parts of the year, they would theoretically be only lightly and seasonally used by elephants. The local density in the areas that did have water would be increased as a result, accelerating the transformation of the vegetation there, and hypothetically leading to the onset of elephant density-dependent self-regulation at lower overall densities than would otherwise have been the case. This idea is unproven in practice, and would only be feasible in very large reserves with a sparse natural distribution of water, such as the Mozambican part of the Great Limpopo Transfrontier Conservation Area.

ELEPHANTS AND BIODIVERSITY

African biodiversity has evolved in the presence of elephants for several million years. Elephant are simultaneously an iconic element of biodiversity, and an important agent that shapes the environment, making it more or less suitable for other forms of biodiversity. Therefore it is not simply a question of 'elephants versus biodiversity': elephants are part of biodiversity and biodiversity depends, to some degree, on the presence and abundance of elephants. There are no comprehensive records, at regional scales, of overall biodiversity changes due to presence or absence of elephants. Much of the discussion below is based on reasonable inference from limited studies.

Elephants are said to be a 'keystone species', in other words, a species which is essential for the integrity of the ecosystem. This assertion is difficult to test critically, but is probably true to a degree. While all herbivores have the capacity to change vegetation structure and composition, the effects of feeding and breakage by elephants affect structural components like canopy trees and are greater in magnitude and extent than the effects of most other herbivores, and thus transform landscape features to a greater degree. Recovery time for the woody plant populations affected is longer than it is for grasses.

In certain circumstances high local elephant densities can contribute to the conversion of savanna woodlands into largely treeless grassland or shrubby coppice states (figure 3). Evergreen succulent thicket can be changed to remnant shrub clumps interspersed with grassy patches. The most extreme vegetation transformations have occurred where elephants have attained densities of 2–3 animals/km^2, generally in association with other factors like drought and range compression by humans. Hotter or more frequent fires contribute to the maintenance of open grassy conditions, with a concomitant reduction in shade-loving grasses. The capacity to form a coppice is widespread in African savannas, and is especially common on sandy soils and where mopane trees predominate. The habitat changes resulting from high levels of elephant impact are generally adverse for other plant and animal species, although some species may benefit, especially at low-to-moderate levels of impact. No global species extinctions have yet occurred as a result of the presence of elephants. The local extinction ('extirpation') of some plant species has occurred in succulent thicket. Sensitive and preferred species, such as baobab trees, certain aloes and other species, may be approaching this threshold in savanna protected areas that lack safe refuges, inaccessible to elephants.

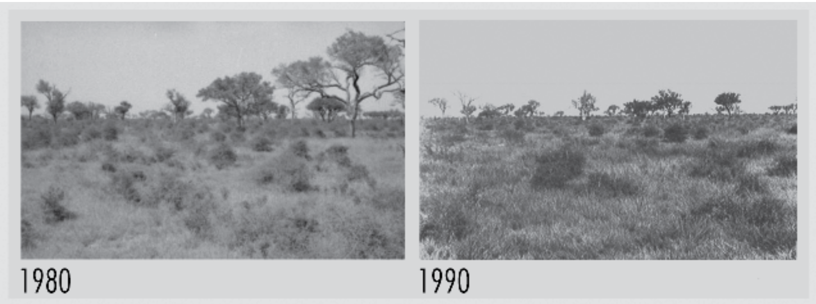

Figure 3: These photographs were taken in exactly the same location and direction ten years apart on the clayey soils of the eastern Kruger National Park. Other photo pairs show little change in woody cover, and some show an increase. On average, the cover by tall trees has decreased in the Kruger Park since the 1970s. Not all of this loss can be directly and unequivocally attributed to elephant impacts

Where elephants consume a large fraction of the forage, other herbivores are likely to be reduced in numbers, especially given the ability of elephants to consume both woody plants and grasses. Elephants selectively favour certain woody plant species over others. Since the most severe impacts of elephants on woody vegetation occur during the dry season, the distribution of perennial surface water can restrict the region over which severe vegetation impacts occur. Bull elephants have greater damaging impacts than female elephants on plants. There are reports of elephants killing other animal species, such as rhinoceros. These incidents are usually associated with animals that were translocated when young, and without the presence of adult animals.

Elephants contribute positively to biodiversity by dispersing seeds, opening thickets, making browse more available to smaller herbivores, making water accessible in dry river beds, and promoting nutrient re-cycling. Thus both the absences of elephants from much of their former range, and the overabundance of elephants in the areas to which they are now restricted, have consequences for the appearance and function of the landscapes and the variety and proportions of species found there. The biodiversity consequences depend not only on the local severity of the impacts, but also on their spatial extent and the period over which they are maintained. Theoretically, a patchy mosaic of severe and light impacts could enhance regional biodiversity. Some species benefit from the more open conditions and vegetation regeneration promoted in heavily impacted localities. Reserves much smaller than the typical home range of elephants may not have sufficient space for heterogeneity in the biodiversity impacts of elephants to be expressed, as essentially the entire area becomes heavily impacted. In large protected areas, the major ecological concern is the lags arising from slow plant recovery following damage by elephants. These can potentially lead to decades-long oscillations in the abundance of elephants and the impacts on affected vegetation and other species.

WILL ELEPHANT NUMBERS REGULATE THEMSELVES?

Because of the long time frames inherent in the interaction between elephant and slow-growing trees, there are no observational data to answer this question definitively, nor are there likely to be within the next decade. The following hypotheses are based on model results and the extensive experience with short-lived herbivores.

There is no reason to believe that elephant populations will behave qualitatively differently to those of other herbivores if left to their own devices: the population within a restricted area will grow to a maximum number, and thereafter could follow one of several possible trajectories (figure 4). The interacting time lags between elephants and tree demographics make the smooth rise to a stable equilibrium (the conceptual model on which simplest version of elephant 'carrying capacity' is based) the least likely scenario under the current circumstances in South Africa. Some degree of overshoot and oscillation is more likely, but there is currently no reliable way of predicting the magnitude and duration of the fluctuations.

'Density dependent' mechanisms will eventually reduce the growth rate of elephant populations to zero or below. There is very little direct evidence from any elephant populations in South Africa that such mechanisms are sufficiently effective at current densities to have resulted in an observable depression of the population growth rate. This does not mean that they are not operative – they may simply be masked by natural variability and the long time-lags involved. There is evidence from southern Africa that nutritional stress, and the high metabolic and time cost of foraging when food is sparse, delay the mean age of first conception in elephants and increase the average period between successive births. The mortality rate of calves increases when food and water are scarce, particularly during periods of drought. Where movement is possible, it is inferred (but not demonstrated) that the deteriorating quality of the highly elephant-impacted habitat will encourage the net emigration of elephant to better habitats. When the birth rate falls below the combined death and emigration rate, the population will decline.

It has further been suggested that at some point, the habitat conditions will recover under the new, lower elephant densities, birth rates will rise again, death rates fall, and elephants may immigrate rather than emigrate. This would lead to a periodic oscillation in elephant and habitat within defined upper and lower limits, known as a stable limit cycle. If many interconnected but uncoordinated locations experience such fluctuations, the result could be an approximately steady total elephant population when averaged over a period of many decades and an area of thousands of square kilometres. This idea has not been empirically tested, and at this stage in the development of southern Africa may only be amenable to theoretical modelling since the practical options for such dramatic range expansions no longer exist. There is no evidence that density-dependent population regulation is itself scale-dependent – in other words, that elephants in larger protected areas will self-regulate at a different mean density than elephants in smaller protected areas. Neither is there evidence in support of or against the hypothesis that in very large ranges, the elephant and tree populations form a stable limit cycle (see figure 4) more or less readily than in smaller areas.

The population density at which the density-dependent mechanisms become effective, the maximum density that the population would reach and the magnitude and period of the subsequent fluctuations, can only be guessed at this point. These numbers would certainly differ between ecosystems, depending among other things on the heterogeneity and size of the elephant range, the species of plant present, the amount, quality and availability of food resources produced by the ecosystem, the degree of competition from other herbivores, the availability of other necessary resources (such as water), or other factors affecting elephant mortality, such as disease, hunting, and predation.

It is clear from existing situations in southern Africa that the appearance of the vegetation in the areas favoured by elephants is already highly transformed at densities well below those where self-regulation of elephant numbers occurs. It is less clear how permanent and significant in terms of ecosystem function these changes are. Most of the elephant-induced changes to ecosystem structure and processes are probably reversible in the very long term (the next 100 years). The loss of tall, slow-growing trees in the savanna biome, such as baobabs, would take such a long time to restore that it can be regarded as irreversible with respect to the current generation of stakeholders, and thus becomes an issue of intergenerational equity.

SETTING NUMERICAL LIMITS TO ELEPHANT DENSITIES

The opinion among the experts who were part of this Assessment is that the setting of a nationwide target maximum elephant density ('elephant carrying capacity') is unfeasible, since the ecological circumstances and management objectives vary so greatly across the country. The evidence is as yet inadequate to permit the rigorous setting of such guidelines on a highly situation-specific basis either. A way forward in the absence of such clear guidelines is to manage elephant populations on a case-by-case basis in relation to land use objectives, rather than directly in relation to their numbers. This could be achieved by setting thresholds of acceptable change in key indicators that are sensitive to elephant impact. Such indicators and thresholds should be tailored to the objectives and circumstances of the area under management. Where the thresholds are reached (or there is a reasonable risk that they will be transgressed within the time necessary to manage the elephant population) then appropriate actions would be triggered. In time, the information that arises from such a learning approach may make it possible to determine defensible rules-of-thumb for elephant density under given circumstances.

INCREASING THE SIZE OF THE ELEPHANT RANGE

The effective range of elephant in South Africa has significantly expanded in the past two decades, through three mechanisms: addition of land to existing protected areas (e.g. Addo); translocation of elephant into new areas, particularly private reserves; and by the creation of transfrontier conservation areas, notably the Great Limpopo and Limpopo/Shashe Conservation Areas. These strategies reduce the effective rate of increase of elephant densities in the source areas, and thus delay the onset of elephant impacts, but do not reduce

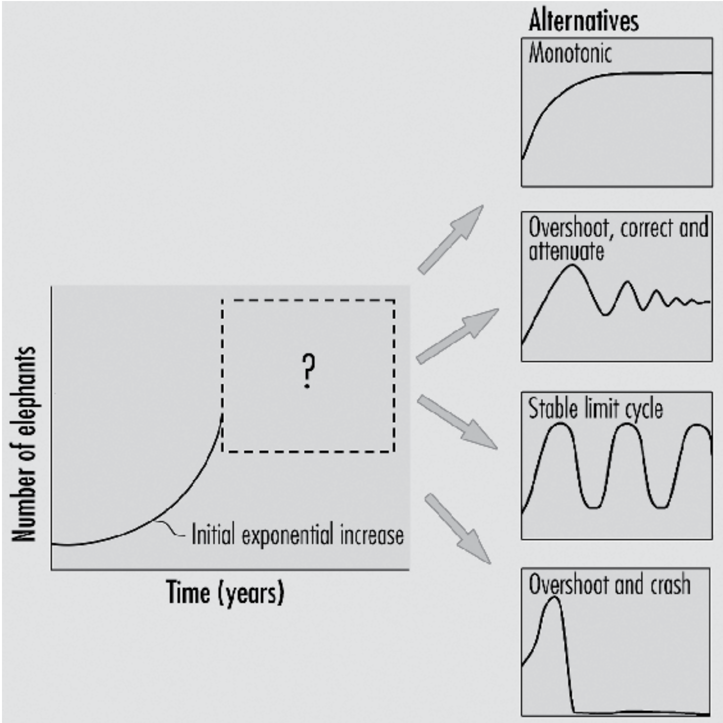

Figure 4: Hypothetical trajectories of elephant numbers. The recovery of elephant populations in South Africa following their near-extirpation in the nineteenth century follows the initial part of these graphs closely, but there is great uncertainty regarding what may occur as elephant numbers rise towards their limit. The number of elephants may (1) continue to increase, with each successive annual increase being slightly smaller than the preceding year until a relatively stable population size is reached; (2) vacillate between high and lower numbers; with diminishing oscillations until relatively stable population size is reached; (3) increase and decrease in a sustained pattern; or (4) increase dramatically and later collapse

the overall elephant population growth rate. By making new resources available, they are likely to allow the population growth rate to remain high for a longer period of time. The elephant density in the new range will, within a few decades, reach similar value to those that have raised concerns in the source regions, and further net migrations or translocations will no longer be possible. The potential within South Africa for further expansion of the elephant range is limited by the density of human settlement and the high degree of transformation for crop agriculture. The scope for future translocation of large numbers of elephant, for the purposes of reducing the elephant density in the source area, is rapidly declining as the recipient areas fill up.

The elephants in South Africa take the form of a few large populations and a large number of small, isolated populations. There are three other large, separated populations in neighbouring countries. Making it possible for elephants to interact between populations (known as metapopulation management), by means of removing fences, connecting populations using migration corridors and translocating elephants between populations, has genetic conservation advantages but no known long-term population control benefits. Simulating a larger, unbounded range by the creation of dispersal sinks through local capture or culling within smaller protected areas may have other benefits (for instance, by creating zones of low elephant impact), but has no population control advantages over non-localised culling or removal.

TRANSLOCATION OF ELEPHANTS

The techniques for capturing, immobilising, transporting and releasing elephants into new environments have been developed in South Africa to the point where elephant mortality is low and the procedure can be done safely (figure 5). It remains expensive and stressful to the animals involved, as well as those within sensory range of the capture operation. The stress can be reduced and the success of the outcome improved by following best-practice guidelines. Proper planning of the translocation operation and the selection of habituated or 'well-behaved' elephants at the capture site are important factors leading to the ultimate success of the operation. Studies of the suitability of the receiving environment for elephants from the particular source population are a necessity. Family groups should be translocated together, and adequately acclimated in a specialised holding pen before release into their new habitat. Translocation does not cure the behaviour of individual elephants with a record of aggression; it simply relocates the problem and should never be attempted.

As most translocations are to fenced protected areas, the dissemination of genetic material is restricted by the small numbers of elephants available to form viable breeding nuclei. It is imperative that management interventions be focused on genetic diversification; if not, a population bottleneck situation, in terms of reduced genetic diversity, will occur on smaller game reserves. Currently, the lack of new receiving areas is the greatest limitation for using translocation as a means of controlling elephant population size. Cost and logistical constraints limit the applicability of translocation as a population control mechanism to relatively small populations.

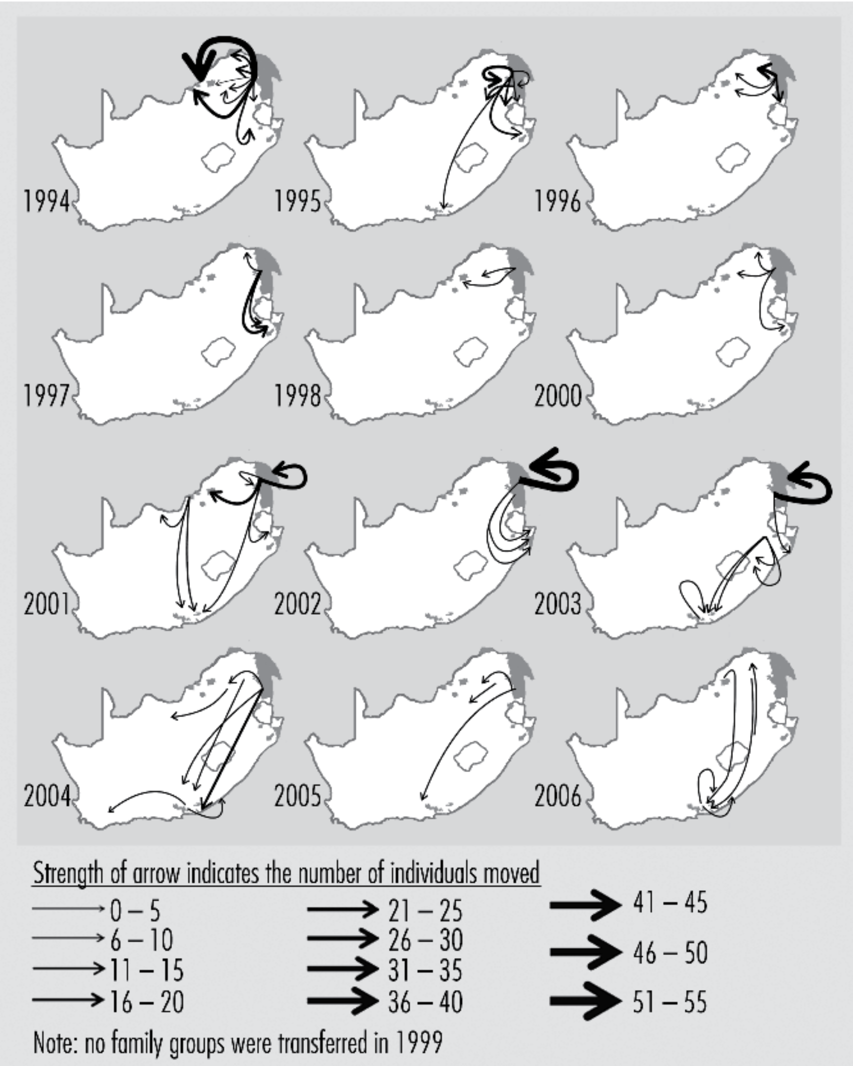

Figure 5: Translocations of elephant family groups occurring in South Africa over the period 1994–2006. Prior to 1994 individual elephants were translocated

REDUCING THE BIRTH RATE IN ELEPHANT POPULATIONS

Immuno-contraception, particularly of female elephants using Porcine Zona Pellucida (pZP) vaccine, has proven to be an effective and viable way of reducing elephant fertility in many situations. It requires that breeding-age cows be injected with a vaccine several times (two to three times during the first year, followed by an annual booster to sustain contraception). The duration of effect following cessation of vaccination in individual cows is thought to be equivalent to the number of years it has been employed. The injection is administered remotely and does not require that the cow be captured or drugged, and has few known direct side effects. Other technologies (such as one-shot vaccines and Gonadotropin Releasing Hormone (GnRH) vaccine), which could apply to either male or female elephants, are promising but not yet proven in elephant field trials. Hormone-based contraception of female elephants has been shown in South African trials to result in unacceptable levels of aggression, as has castration of bulls. Vasectomies are effective and can be performed without long-term health consequences for the bull elephant, but expense is likely to restrict their use to populations in small, protected areas.

The long-term physiological, behavioural and ecological consequences of widespread contraception of wild elephants are not known, since the trials have been under way for less than eight years. Immuno-contraception is reversible in individuals that have been vaccinated once or twice, but it is not known if it is reversible after three or more treatments. Indications are that reversal after multiple immunisations is slow.

At present, mass contraception has been limited to elephant populations of fewer than about 300 individuals, often under intensely studied conditions where individual cows can be identified and located for re-immunisation. In principle, the vaccination technique could be applied to much larger populations, targeting all mature females rather than specific identified individuals. Accidental vaccination of a pregnant cow has no known negative impacts on the foetus, and multiple-vaccination within a few weeks is not likely to be detrimental to the health of the cow other than its effects on fertility. Successful contraception of about four-fifths of all breeding-age females would lead to a birth rate that approximately matches the inherent mortality rate – that is, population stabilisation.

Because of the longevity of elephants and the 22-month gestation period, contraception is not a technique for reducing elephant numbers in the short term (within a decade or so). It is therefore ineffective for reducing the ecological impacts of elephants once they are already apparent. It is a preventative measure that must commence suitably in advance of the time when unacceptable elephant impacts are anticipated. Primary pZP vaccinations of cows during translocation could be considered as a useful tool to control populations in their destination area. A single vaccination does not cause infertility, but causes the animal to respond quickly to vaccination boosters at a later date, and so reduces the lag period and cost of subsequent contraception.

LETHAL MANAGEMENT

Culling and translocation are the only management options for reducing elephant densities (and thus local impacts) where intervention is urgent – that is, taking effect immediately or within five years. Shooting the animal is usually the only option for the control of individual elephants, in cases where rapid response to threats to human life is required. It is also the most practical option for persistently aggressive or damage-causing animals. Key ecological concerns associated with culling include the partly uncertain (but probably substantial) impacts on the behaviour of the surviving elephants, and the increase in the underlying population growth rate that can result from reducing elephant numbers and disturbing the age and sex ratios. It is possible, but unproven, that an elephant population made artificially younger by age-selective culling could be more prone to overshoot its resource limitations. It is likely that once culling is adopted as an elephant population control method, it must be continued indefinitely or until replaced by another method. Culling, like other high-consequence management options, should be guided by a structured decision-making process. Culling is indicated only once other population management options have been considered, evaluated, and rejected. The preferred method is a single lethal shot to the brain, delivered by a skilled marksman from a helicopter. In the case of females and young animals, current best practice is for the entire family group to be culled at once, and not in the near proximity of other elephants.

THE ECONOMIC VALUE OF ELEPHANTS

Elephants are generators of economic value in the ecosystems in which they occur, and under current circumstances in South Africa only at a minor cost relative to the value of the animals. Having more elephants does not, however, imply that the net economic value will increase proportionately. At some population size the costs associated with destruction to property, threat to human life and degradation of ecosystems by elephants would exceed the benefits.

The total economic value of elephants consists of both direct and indirect values. Some of the former are consumptive (i.e. the elephant must die before the value can be realised) while others are non-consumptive. Currently the total economic value of elephants in southern African countries is overwhelmingly dominated by the so-called ‘existence’ and ‘bequest’ values – in other words the hypothetical price that people, mostly not living near to the elephants (or even in southern Africa), are willing to pay to know that wild elephants exist and will continue to do so (table 1). Only a small fraction of this notional value is currently realised through wildlife tourism. Recent advances concerning payments for ecosystem goods and services and the development of markets for these services indicate that through institutional change it is indeed possible to harness more of the existence and option values of elephants in future.

The direct use value that could be realised through the sustainable harvesting of elephant for ivory, hides, and meat in South Africa is limited by the CITES ban on the trade in elephant products to a few millions of rand per year, but is likely to rise again in the future. Nevertheless, even under unrestricted market conditions the direct use value is likely to remain much smaller than either the existence value or the non-consumptive ecotourism value. The degree to which consumptive use (e.g. hunting) might reduce the realisation of the existence value (e.g. by deterring tourism) is unknown.

Component		Value per elephant (ZAR/y)	Total value (ZAR billion/y)
Non-consumptive use	Existence and bequest	29 614	14.7
	Viewing by tourists	10 506	3.9
Defensive expenditures	Protection cost	2 010	1.1
	Damage compensation	1 173	0.6
	Translocation cost	19 095	0.01
Consumptive use*	Ivory	1 291	0.8
	Hunting	290 000–500 000	0.08–0.04
	Live elephant sales	15 000–500 000	0.01–0.3

*This is currently a restricted market and the values are therefore skewed towards the low side.

Table 1: Indicative values in 2007 for the various components of the 'Total Economic Value' of elephants in South Africa. Extensive use has been made of studies in Zimbabwe, Botswana, and Namibia to estimate some of these values, assuming an exchange rate of 6.7 ZAR/US$. They may not be accurate for South Africa, but the relative ranges of the values are likely to be correct. A billion is 109

THE LEGAL ISSUES RELATING TO ELEPHANTS

South African wildlife laws are rooted in Roman-Dutch common law and are expressed in many overlapping (and at times conflicting) statutory enactments at the national, provincial and local level.

Central to the treatment of wild animals in South Africa's law is their definition in the law of property as *res nullius* (belonging to no one) in certain circumstances, which may include large state-owned protected areas. It is submitted that this notion, and the law that is built on it, is inconsistent with South Africa's customary law, the National Environmental Management Act and the Constitution. It is also out of step with the current social perception that wild animals, particularly those occurring in protected areas or escaping from protected areas, are part of the national heritage and should be protected as such. Similarly, the recognition in international law of the concept of a global commons, of which wildlife heritage is an inextricable part, is also not reflected in South African common law.

The application of the *res nullius* principle in many instances results in the national heritage being diminished in circumstances that are not reasonable, justifiable or in the public interest. This increasingly untenable situation could be addressed through a redefinition of the common law by way of judicial intervention and interpretation. This could be a starting point for a revision of relevant legislation and policy regarding elephants, but would also be relevant to securing the status of thousands of other species.

MANAGING COMPLEX SYSTEMS CONTAINING ELEPHANTS

The existence of clear strategies for elephant management, conscious of the social and ecological factors involved, and explicit about the conceptual models on which they are based, would assist in guiding coherent and effective elephant management actions. The approaches that have been applied to elephant management have evolved over time, and will continue to do so. Despite the widely shared respect for elephants, 'moral plurality' about how to manage them (i.e. fully or partly incompatible views) is likely to be a reality for elephant-related issues in South Africa for the foreseeable future, since no single set of values is clearly dominant or ascendant.

For issues such as elephant management, where both the ecological and human systems involved are complex and incompletely understood, the current best practice approach is 'active adaptive management' (figure 6). In adaptive management, actions are accepted as being provisional, and are undertaken as deliberate experiments, with the necessary controls and before-, during-, and after-the-fact data collection. The results of the experiment are then used to refine future management, including the possibility of changing the goals which it seeks to achieve if they prove unattainable or inappropriate (figure 6).

There is consensus among the elephant experts engaged by this assessment that a single set of policies and management rules cannot be applied to all situations where elephants occur in South Africa. Nonetheless, useful guidelines, based on research, can already be provided for the main situations that occur in South Africa (table 2). The appropriate management depends on both ecological factors (such as the type and condition of the habitat, the elephant density and the size of the area, and the presence and status of other species) and human factors (such as the objectives for which the area is managed, the proximity to other land uses, and the economic and technical capacity to undertake certain actions).

The policies appropriate for South Africa are not necessarily applicable in other African countries. Management of elephant populations that straddle international frontiers (such as those in Maputaland, Limpopo, and Mapungubwe) should be at least coordinated, and preferably harmonised, on both sides of the border. Similarly, populations that move between private and public protected areas would benefit from being managed in an integrated and consistent way, but not necessarily identically in both tenures.

WHAT DO WE STILL NEED TO KNOW?

All areas of research into elephants, the ecosystems that contain them, and the societies that care about them, contain residual uncertainty that could be reduced (but not entirely eliminated) by further research. However, there are certain topics on which better understanding is particularly urgent or important from the perspective of elephant management, at all scales from the individual protected area to the subcontinent.

- The trends and societal distribution of human value systems that underlie conflict around the management of elephants, and better ways of managing issues that occur within a context of conflicting value systems.
- The economics of elephants in South Africa, in particular the ways of ensuring that the potential benefits from elephants reach those with the greatest need for them, and the strength of the trade-off between use values and non-use values.
- The long-term physiological and behavioural consequences of contraception, and the practical implications of contraception in large elephant populations.
- The importance and persistence of stress in elephants induced by exposure to culling or hunting, capture, translocation, and separation from clan members.
- Examining stress, behaviour and demographic vital statistics in elephant populations at differing densities – what are the effects of being subjected

to, or being maintained at, high densities, and what are the biodiversity consequences?

- The effects on various elements of biodiversity – including composition, structure, and function – of increasing levels of elephant pressure, in all major ecosystems in which they co-occur in South Africa.
- The potential to control elephant distribution by behavioural modification.
- The feasibility and consequences of achieving elephant population self-regulation by concentrating elephant densities in a portion of the potential habitat, through for instance manipulation of water availability.

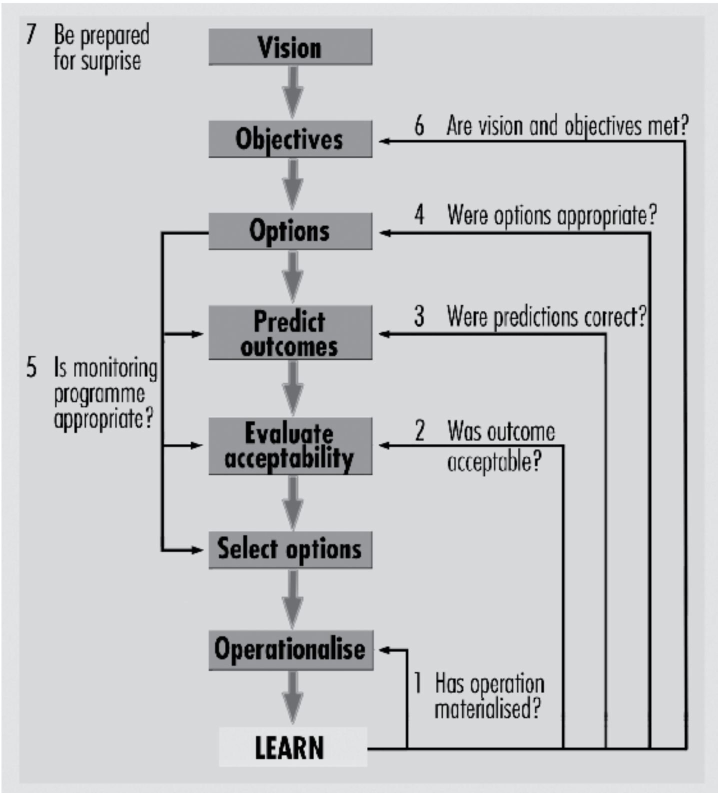

Figure 6: Diagram showing the process of adaptive management, illustrating the sequence of actions and analyses aimed at deriving and implementing the objectives, and enhancing management over time. This version of the adaptive management approach was developed by S Pollard, K Rogers, and H Biggs

<table>
<tr><th rowspan="2">Ecosystem type</th><th colspan="2">Primary management objective</th></tr>
<tr><th>Biodiversity conservation (mainly state protected areas)</th><th>Tourism income (mainly private or communal areas)</th></tr>
<tr><td rowspan="3">Semi-arid savannas and their included riparian forests</td><td>Large areas (>5 000 km^2):
Laissez-faire may work in certain areas or particular circumstances. If not, and if sufficiently arid, attempt limiting elephant range by controlling perennial water supply. Internal translocation and localised mass contraception to protect areas of high sensitivity. Appropriate fencing on all boundaries adjacent to inhabited areas. Impact indicators relate to the maintenance of landscape-scale biodiversity and thresholds linked to degree of reversibility in 25- to 50-year timeframe.</td><td rowspan="3">Medium and small areas:
Long-term population control by individual contraception, short term by translocation to other private areas, or culling if no recipients are available. Elephant-proof fencing of any boundary adjacent to crop agriculture or human settlement. Key indicator of elephant overpopulation is effect on the overall economic viability of the land use.</td></tr>
<tr><td>Medium sized (50–5 000 km^2):
Laissez-faire unlikely to work. Long-term population control can be considered by individual contraception. Short-term control, if unavoidable, by translocating or culling. Elephant-proof fencing on all crop, agricultural or human settlement boundaries. Impact indicators tied to sustainability and the preservation of unique features of the area, such as patches of specialised habitat.</td></tr>
<tr><td>Small areas (<50 km^2):
Do not introduce elephant, translocate out if already present.</td></tr>
<tr><td>Species-rich restricted-range ecosystems*</td><td colspan="2">Elephant-resistant exclusion fences around the most threatened plant communities. Long-term population control by individual or mass contraception. Short-term control, if unavoidable, by culling. Impact on rare species not adequately represented outside of management area is key indicator of the need to limit elephant densities, threshold is minimum viable population (plus safety margin) of these or indicators of significant landscape degradation (e.g. Landscape Functionality Index [LFI]).</td></tr>
<tr><td>Arid shrubland (Karoo)</td><td>Stocking with elephant not recommended. Historical evidence for the necessity of continuous presence of elephant is weak and seasonal stocking is unfeasible.</td><td>Should be contemplated in medium to large areas only. Restriction of access by limiting distribution of perennial water should control elephant impact.</td></tr>
<tr><td colspan="3">* e.g., Thembe dune forest and Addo succulent thicket</td></tr>
</table>

Table 2: An example of differentiated guidelines for the management of elephants in South Africa