ELEPHANTS

A way forward

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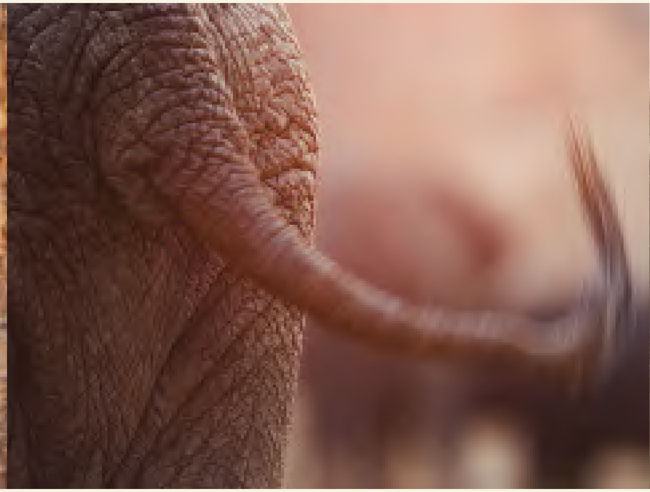


"Ecological networks connect fragmented ecosystems and species populations."

FOREWORD

Issues surrounding the conservation, management and welfare of Africa's elephants are complex. We now know that elephant numbers in some populations have stabilised naturally, others are increasing, while some populations are being depleted by escalating poaching and ongoing habitat loss. Where elephants are confined by fences, damage to vegetation is real, especially in small protected areas and around water sources. Human-elephant conflict due to crop raiding in areas where elephants range onto land where people live is another management concern. It is around these hotspots of contention between humans and elephants where calls to reduce elephant numbers, curb growth rates and reduce impact on people and on natural vegetation, continue to dominate, or rather, complicate, local discussions.

Arguments about elephant management are often extremely polarised. For instance, management to reduce numbers or to confine elephants solicits responses from people concerned about the welfare of elephants. While some interpret these concerns as 'animal righteousness' and support culling and hunting to control numbers, animal welfare and associated values should be part and parcel of conservation management decisions, i.e. management cannot be considered in a vacuum. At the end of the day, a concern for the welfare of individual elephants, populations and their habitats should be seen as a realistic and not idealistic management objective. While people sometimes are at odds as to the method employed to limit elephant numbers or their impact on other species, the majority seek the same outcome, a harmonious environment where elephants are not viewed as a 'problem'. All of these issues need to be addressed and this is where scientific research has a key role to play.

For the past 50 years many scientists have made a concerted effort to contribute to the scientific knowledge that may facilitate the well-being of elephants through appropriate conservation and management measures. This booklet is a further contribution to this effort. It should inform whoever is interested in elephants. The booklet is based on knowledge that Rudi van Aarde and his students, have gained through scientific research on elephants in southern Africa over a period of some 20 years. It has an element of advocacy and calls for the development of ecological networks to conserve elephants and to serve as frameworks for their management.

IFAW has partnered with the Conservation Ecology Research Unit (CERU) of the University of Pretoria on a research programme aimed at understanding the dynamics of elephant populations in southern Africa. IFAW's interest in the conservation management of elephants in the region spans almost 20 years. Through dedicated support for research and practical solutions, IFAW aims to promote ethical and scientifically sound policy solutions to conservation management predicaments involving elephants.

IFAW trusts that its support of *Elephants – a Way Forward* will continue this important debate ensuring that all decision making on behalf of elephants is done with their best welfare at heart. **– Jason Bell, IFAW, Director Elephant Programme, Director IFAW Southern Africa**

INTRODUCTION

About half a million elephants live in Africa's savannahs. Is this too few, or too many? Before the previous onslaught for ivory half a century ago, we may have had 1.3 million elephants roaming the continent! To regain our losses might not be sensible, or practical. The reason is simple – African savannahs are no longer what they used to be.

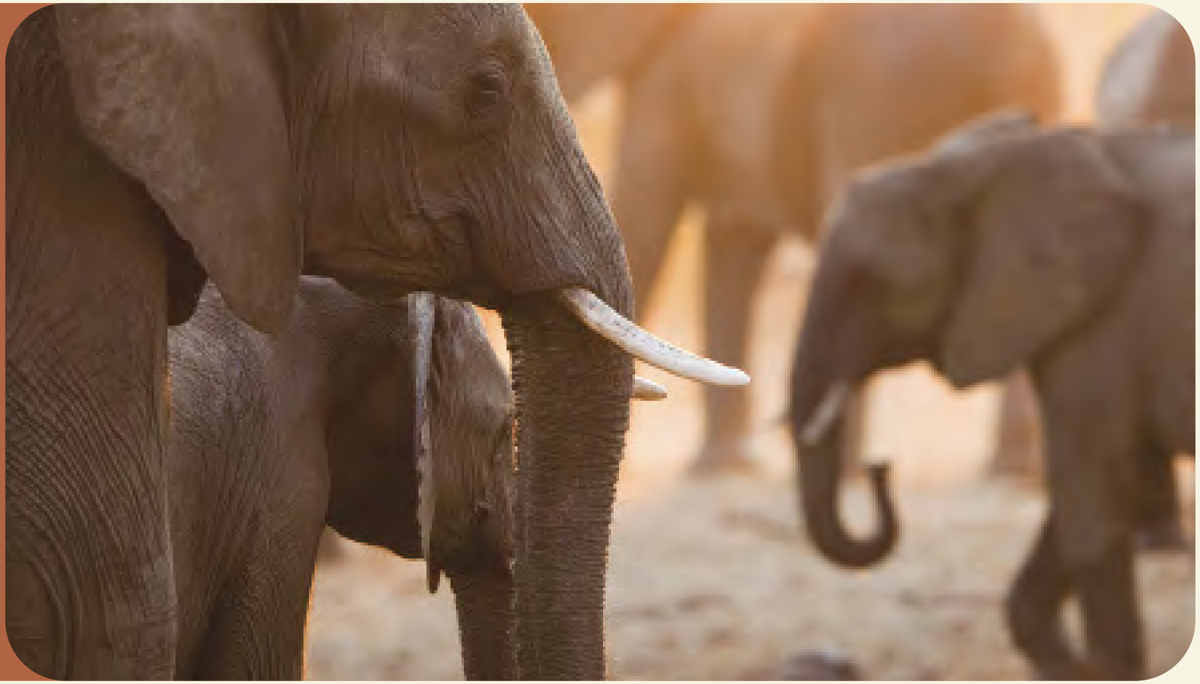
Elephants that once might have roamed across most of the continent now mostly live in formally protected areas. In total, these areas probably account for only a third of their former range. Since the previous onslaught on elephants for their ivory, we have set aside more land for conservation and hence may be in a position to support more elephants. Does this mean that we can regain some of our losses? The answer to this must be no, given that elephants in some 70 per cent of their range across southern Africa now share the land with more people than ever before. The answer also could be that we already have regained our losses and now have more elephants than what the available land can cope with. We simply do not know if this is the case, but we do know that elephants do well on protected land. We hence should not be concerned about regaining earlier numerical losses, but should rather focus on maintaining what we have. Our emphasis should be on recovering and stabilising the ecological processes that can limit elephant numbers and provide for their needs without detracting from the needs of the other species with which they share the land. The needs of elephants are relatively simple – fodder close to water and distant from people, trees under which to shelter from the heat of the day and the cold of the night, as well as enough land to move around on as seasons and resources demand. To provide for these needs we need appropriate space.

In recent years elephant numbers have stabilised in several protected areas. These include areas not exposed to excessive poaching, areas not fenced, and areas that allow for the dispersal of elephants. However, in parts of southern Africa numbers continue to increase where fences hinder movements and where water provisioning releases elephants from ecological limitations. Fences and water also alter space use patterns and this drives the impact elephants have on vegetation and other species. This type of impact continues to fuel calls to reduce elephant numbers, but often is a mere reflection of a dysfunctional ecological system, mostly due to our activities. In such cases emphasis could be on healing the system rather than on blaming elephant numbers.

What management options do we have to heal such systems? Can we stem the impact that elephants have on other species? Is the land that we have set aside for conservation enough to sustain elephants indefinitely? Can elephants take care of themselves, their numbers and their habitat? If not, what can we do to assist them? To address these questions we need to know what causes the perceived elephant problems. Yet, even if we find all the answers, the future of elephants across southern Africa may not be secure, especially with the recent escalation in poaching. Political instability, poor governance, lack of societal values, land degradation and the renewed syndicate-based poaching could derail well-founded conservation measures. Assuring the future well-being of elephants, therefore, is complicated, but science has a role to play in unravelling some of these complex issues.

Scientists, true to their nature, will continue to debate their findings as more information is gathered. Debates will continue to improve our understanding and should not be construed as conflict between scientists or between scientists and society. In addition, the complexity of the situation should neither justify indecision, nor result in support for decisions based on experience and opinion alone. A decision supported by validated information remains the best way forward. This booklet is not a management plan for elephants, or a recipe for dealing with elephant problems. It is an amalgamation of scientific knowledge and experience that calls for the provisioning of space for elephants in order to meet their conservation needs.

What do we mean by space for elephants? In ecological terms space is not only about area or size, but also about the land that provides for the variety and distribution of resources that a species needs to persist. These include the variability in living conditions, the distribution of and distances between essential resources, the connectivity between ideal habitat and the configuration of ideal and marginal habitat.

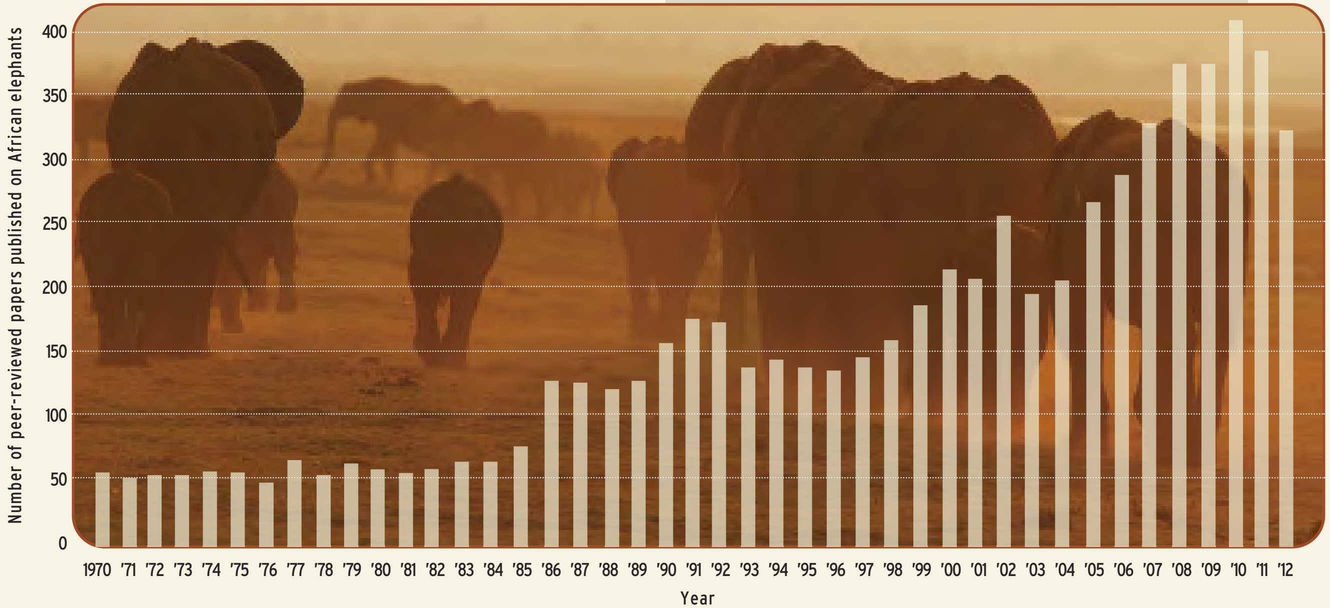


WHAT DO WE KNOW ABOUT ELEPHANTS?

What we know comes from dedicated, long-term and innovative research

Early research on elephants focused on illustrating their impact on vegetation. Some of these research projects justified culling as a measure to limit elephant numbers. Later on, research on the behavioural ecology of elephants highlighted the intricacies of the social system of free-ranging elephants and found some support for anecdotes of their intellectual abilities. Long-term studies in East Africa probably yielded most of what we know about the behaviour and life history of savannah elephants. Material from large-scale culls across parts of East and southern Africa between 1960 and 1994 provided detailed information on the population and breeding biology of elephants. At that time the counting of elephants throughout most of the continent, mainly through aerial surveys, also commenced and thereafter became a routine research tool and remains one to this day. Research proliferated, and from 1960 to 2012, the number of research publications on elephants increased exponentially, illustrating not only an increase in research activity but also an increase in the number of scientists participating in such research.

While research questions have changed little over time, research techniques have changed a lot. In addition, technical development has boosted our ability to understand elephants. Scientists now rely on relatively sophisticated technologies, modelling exercises and analytical routines to reduce immense volumes of information into sensible inferences. Modelling exercises improve scientific understanding, but models and their outcomes are only simplifications of reality. These models inevitably include uncertainties, and scientists cannot allow for the uncertainties that occur beyond their simplified realities. They therefore continue to design studies to reduce such uncertainties. Scientists understand this, but others may interpret uncertainty as a shortcoming.



The figure is based on information extracted from the Institute of Scientific Information (ISI), Web of Knowledge Search Engine (16 January 2013).

Elephants, evidence and ecology

Ecology as a science plays a pivotal role in society and could advance debate, inform public opinion, assist political decisions and guide the development of conservation and management actions. Scientists have written extensively about Africa's elephants, much more than on any other African mammal, other than the chimpanzee. Why then write more? Literature accessible to the layperson is mostly in the form of newspapers, wildlife magazines, dedicated internet sources, and books on elephants or African wildlife in general. Some of these are written by scientists and others by journalists and/or keen conservationists. Most of the information provided through these mediums, however, has not been exposed to scientific scrutiny as is typical for information published in scientific journals. This booklet also is not peer-reviewed but an interpretation of information that has been published in peer-reviewed journals.

We know where elephants live

Southern African savannahs support nearly 39 per cent of the known range of elephants in Africa. About two thirds of all savannah elephants live here, most of them in protected areas that account for about a third of the land area of the sub-region. But elephants also live beyond the boundaries of protected areas. In fact, nearly 70 per cent of their estimated range stretches beyond formally protected zones, and at least a third of southern Africa's elephants may live on land that is not protected. This includes areas in northern Namibia and northern Botswana, a few places in Zambia, and parts of Zimbabwe, Angola and Mozambique. Some elephants thus exist entirely without the benefits of protected areas, while the ranges of others include, but also extend beyond the boundaries of these areas.

About three quarters of the subcontinent's elephants live in Botswana (130 000 elephants), Tanzania (110 000) and Zimbabwe (80 000 – 100 000), while countries such as Namibia, South Africa and Mozambique each house fewer than 30 000 elephants. Malawi has few elephants (maybe less than 2 000) and estimates for Angola are anyone's guess. However, elephants generally disrespect border controls and populations stretch across international boundaries, especially where protected areas abut national borders. Consequently some elephants freely move between countries – Botswana, Namibia, Zambia, Zimbabwe, Mozambique and South Africa definitely share some of their elephants!

Southern African country profiles

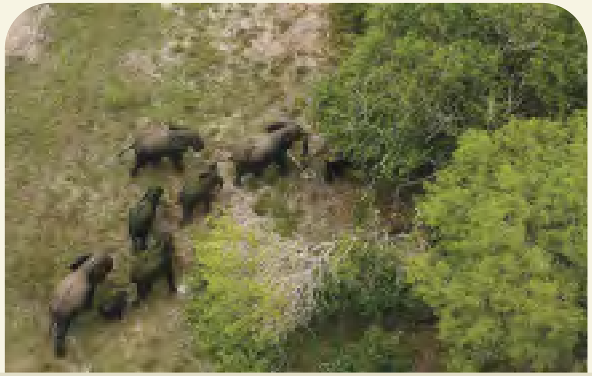
For elephants things differ from country to country. In alphabetical order:

ANGOLA

Information on elephants in **Angola** is limited to surveys across the southern parts that suggest that relatively large-scale recolonisation from Botswana and Namibia may explain steep increases in population size. Our recent satellite tracking studies and those of *Elephants Without Borders* (EWB) support the notion, though cross boundary movements were also prevalent during the early 1990s. Angolan populations were severely depleted during the decades of civil strife and war, possibly to finance military operations.

BOTSWANA

Elephants in **Botswana** mainly roam across some 80 000 square kilometres of the northern parts of the country. Few fences other than those along international boundaries hinder movement and the populations appear to be structured into sub-units with differing demography and spatial use patterns. Numerically the population has been stable at around 130 000 individuals for nearly a decade. Dispersal into neighbouring countries continues but genetic studies imply no breeding herd related gene flow between Botswana and neighbouring Zimbabwe and some gene flow between Botswana and southern Zambia. Bulls roam freely across the region. Spatial use patterns are influenced by the presence of people and conflict between elephants and people is a major concern. Management is limited to well-structured and effective anti-poaching campaigns and the provisioning of water across the hinterland. Elephants are valued for their contribution to society and to a flourishing tourism industry. Research is well founded, long-term, sanctioned by local authorities, and funded through foreign resources that support EWB. The government is a leading supporter of transfrontier conservation initiatives.



NAMIBIA

In **Namibia** elephants mainly occur in the northern parts of the country where about 20 500 individuals roam freely beyond protected areas. Some 3 300 elephants are confined to the fenced Etosha National Park. Other elephants are partially confined, notably the ~2 700 individuals in the Khaudum Game Reserve. Dispersal into neighbouring countries mainly involves elephants living in and crossing the Caprivi region when roaming into neighbouring Angola. Rural communities suffer from conflict, especially where elephants are lured to limited water sources. Many of these communities embrace conservation and benefit financially from NGO-driven incentives. Water provisioning features highly in management dominated by a utilitarian philosophy. Political support for transfrontier conservation initiatives is in place and may benefit local elephant populations. Research is mainly conducted and supported by foreign institutions.

MALAWI

Malawi is a relatively small and densely populated country with only a few protected areas that collectively house no more than 2 000 elephants. Human-elephant conflict around some protected areas is intense, though few elephants stray onto these areas. International donors support research, rescue operations to translocate elephants from rural areas to protected areas, and efforts to stabilise or recover populations, and the government sanctions such incentives. Research and monitoring activities are intermittent and suggest that some confined populations are recovering faster than others.

MOZAMBIQUE

In **Mozambique** most elephants (~22 500) live in the northern province where they are free to roam between protected areas and adjoining community and concession lands. Some 7 000 elephants live in other parts of the country. Most populations have been severely depleted, but since 2000 some are recovering at relatively slow rates. Renewed poaching is a major concern, especially towards the north and along the Tanzanian border. Populations along international borders share space with South Africa, Zimbabwe, Zambia and Tanzania. People inhabit protected areas and conflict with elephants is relatively high; it also occurs in zones surrounding parks. Conservation management focuses on reactive approaches to poaching, and attempts to reduce conflict feature high on the political agenda. The government subscribes to activities to protect elephants and facilitates the recovery of depleted populations through its participation in transfrontier conservation incentives. Most research on elephants in the country is financed through international donations. Monitoring of elephants is intermittent and usually conducted by foreign consultants.

SOUTH AFRICA

Most (~23 000 in 2012) of **South Africa**'s elephants live in the Kruger National Park. Populations other than in the Addo Elephant National Park and the Tembe Elephant Park comprise 54 populations that are fenced in and confined to small provincial reserves and private properties. New populations continue to be founded on privately owned game reserves. Incidences of conflict and poaching are low. Conservation infrastructure is well developed and research capacity enormous compared to other southern African countries. National and international agencies fund research activities. Transfrontier conservation incentives are also well established, and SANParks officially supports management incentives that focus on spatial manipulation to reduce impact, rather than the 'command-and-control' approach of the apartheid era. Elephant management in provincial parks and on privately owned land favours contraception to inhibit population growth.

ZAMBIA

Some 26 000 elephants are reported to live across 72 per cent of **Zambia**'s protected areas. The largest continuous and free-ranging population of about 19 000 individuals occurs in the Luangwa Valley where incidences of conflict and poaching are common and disturbing. Most elephants in Zambia live in national parks and the surrounding game management areas that collectively account for nearly 30 per cent of the area of the country. Conservation management is largely directed at reducing conflicts, and few populations are exposed to fences and water provisioning. Zambia shares populations with neighbouring Malawi, Angola, Botswana, Namibia and Zimbabwe. In general, population monitoring is at low intensity and intermittent frequency. Political debate on elephants focuses on conflict, anti-poaching campaigns and legitimising ivory sales, and Zambia's sanctioning of transfrontier conservation incentives stands elephants in good stead.

ZIMBABWE

Some 80 000 to 100 000 elephants may live in **Zimbabwe**, half thereof in the north-western parts and on protected land that adjoins international borders and similarly protected areas. Elephants are not fenced in and are free to roam across the landscape, however there are reports that incidences of human-elephant conflict and poaching are increasing. All of Zimbabwe's major elephant populations are located along the borders of neighbouring countries and movements are most likely taking place between them. Several NGOs play instrumental roles in safeguarding and monitoring elephant numbers in some areas.

We know where elephants would like to live

Elephants that have a choice prefer habitats that range from sparsely wooded riverbeds in western deserts to densely wooded forests along the eastern extremes of the subcontinent. Most elephants, however, are particularly at home in savannahs. Here rain falls in the summer, and areas that suit elephants best are mostly close to water, mainly along the major rivers and temporarily rain-filled drainage lines that weave across much of the southern African region.

Confinement by fences may limit the choices available to elephants, but even in such places elephants continue to find certain landscapes and habitats more attractive than others. Elephants typically prefer to live far away from people, where it is relatively green, but most importantly, where they are close to water. However, they will venture close to people when lured by green crops and water.

Free-ranging elephants appear to avoid contact with rural people. On a daily basis, they achieve this by altering their drinking behaviour. For instance, along the Okavango River in northwestern Botswana, people are active in fields close to the river during the day, while elephants visit areas close to the river at night, thereby minimising the time that elephants and people are in close proximity. In other cases elephants may avoid areas close to settlements and vacate areas entirely when human densities reach a particular threshold. This threshold differs from place to place, probably as a function of the extent of land conversion rather than the actual number of people living there.

Interconnectedness: Elephants and water

Elephants need to drink to negate water loss, as is typical of large-bodied animals living in relatively hot and dry environments. They also need water and use mud to remain cool during the heat of the day, especially during the summer months. Most elephants seldom roam beyond ten kilometres from water. They therefore use areas close to water more intensely than areas farther afield. This uneven use of land allows vegetation some distance from water supplies to escape destruction. This is not the case where watering points are evenly spread and at short distances from each other. This is the situation on most small estates. In such places the relatively short distances between water points reduce the home range areas of elephants, intensifying and condensing their impact on vegetation. Here water placement also allows elephants to occupy land that otherwise would have lain unused during normal rainfall years and that might provide fodder during dry spells when resources close to water would be exhausted. Consequent die-offs due to starvation during droughts are more intense in places where water is provided than where water is not supplied.

"Food availability and quality can also limit breeding and survival rates, more so when elephant densities are high than low."



We know what happens when elephant numbers increase

Elephants that are free to move may extend their ranges when numbers increase. Local densities (elephants per unit area) therefore may remain relatively constant. This happened in northern Botswana when elephants were free to move onto vacant land. However, densities increase with numbers where fencing, human populations or other factors limit the area elephants can occupy. This was the case in South Africa's Kruger National Park when fences surrounded the boundaries of the park. Elephant distribution across the park became more even as numbers increased, but densities close to the rivers and some artificial water points remained higher than elsewhere in the park.

Based on our recent studies across southern Africa, we also know that population growth declines with increasing densities. Scientists refer to this phenomenon as density dependence, which may ultimately be caused by the depletion of food resources. Food availability and quality varies with rainfall and soil conditions and can also limit population growth, conceivably more so when elephant numbers (densities) are high than low. Food limitation could influence population growth by inducing increased calf mortality and decreased reproduction. Density dependence in population growth has been recorded for elephant populations in the Serengeti (Tanzania), the Hwange National Park (Zimbabwe), in parts of northern Botswana and in the Kruger National Park.

Unusual events can reduce elephant numbers. For instance, in the Tarangire National Park (Tanzania) an unusual drought in 1993/94 killed 20 per cent of calves. In Hwange National Park (Zimbabwe) periodic droughts kill five to nine per cent of all elephants, and up to 85 per cent of calves may die during severe and extended droughts. Perhaps the most extreme example of drought-related elephant die-off on record comes from Tsavo National Park in Kenya where some 6 000 elephants died during 1970 and 1971. Extreme events do not limit elephant populations over the long-term but accentuate the influence of density on population growth. From studies in East Africa we know that conception rates of elephants during La Niña drought events can be as low as zero, but as high as 58 per cent during wet spells associated with El Niño events when food quality is high. In southern Africa unusual dry and wet spells could explain large scale variation in the growth rates of established elephant populations.

We know that conditions during the first few years of an elephant's life may drive population changes, probably due to the vulnerability of young elephants to drought and increased roaming distances of breeding herds when densities are high. We also know that first-year survival drives population responses in dry savannahs while, in wetter savannahs, variation in birth rates generates population change.

We know that elephant populations grow at varying rates

Without immigration, the highest average rate of increase that well-established elephant populations can sustain for an extended period is 5.7 per cent per year, but only if cows give birth at the earliest possible age (~10 years), repeatedly give birth at the shortest possible interval (~4 years), and only stop giving birth when old (~60 years). Thus, most populations should increase more slowly. On the other hand, high population growth rates are possible over the short-term, especially in small or disrupted populations where sex ratios or age structures are abnormal and breeding events are synchronised. In these populations short-term rates of increase can escalate to 25 per cent. Immigration and emigration also affect growth rates, and can induce dramatic changes in population numbers from year to year. For example, due to large-scale movements, yearly changes in population numbers can vary from minus 88 per cent to plus 148 per cent.

Immigration also explains the establishment of new populations. Such has been the case for the Kruger National Park where less than ten elephants may have been present in the area in 1900. Colonisation took place from Mozambique and elephants colonised all of the present day area of Kruger within 50 years at a rate of seven to ten kilometres per year.

Elephants also re-colonised the Serengeti National Park in Tanzania after an absence of 40 years. In some cases human actions can spur immigration. The provision of water certainly enabled elephants to colonise and permanently occupy areas that were relatively inhospitable, especially during the dry seasons, such as Hwange in Zimbabwe, and the Etosha National Park and Khaudum Game Reserve in Namibia.

Northern Botswana as a case study

The recovery of Botswana's elephant population certainly is something to rejoice, but the destruction of vegetation along the riverfronts is a matter of concern. Here elephants do destroy some trees, especially acacias, baobabs and marulas. They also stunt growth in mopanis and combretums. This, however, needs to be placed in context. Firstly, the accumulation of dead trees in places along the floodplains of the Chobe and Linyanti Rivers may be due to natural die-offs and slow decay of hardwood species. Secondly, over-hunting and an outbreak of rinderpest during the early 1900s decimated wildlife. Wildlife numbers remained low for at least half a century, and this provided an unusual opportunity for dense woodlands to develop, especially along riverfronts. However, in the wake of conservation, wildlife numbers increased, and the dense woodlands along the riverfront declined to a state more natural than the anomaly that developed in the absence of wildlife and specifically elephants. The area of disturbance, known as a piosphere, that now persists is typical of floodplains throughout southern Africa. However, the impact of elephants on vegetation in areas around artificial water points beyond floodplains in the Chobe National Park and elsewhere should be a matter of concern and calls into question the contribution of these watering points to conservation.

I often get confronted with statements such as 'there must be too many elephants as many trees are wrecked and uprooted'. This generalisation is not backed by elephant counts, but is based on the apparent ill effects of elephants on individual trees. A more accurate statement may be 'elephants break and uproot many trees', even if no trees were counted.

ECOLOGICAL ENGINEERS OF THE SAVANNAHS

We know that elephants change vegetation

There is no doubt about it, elephants trample, pollard, debark, uproot and break trees. However, they also disperse the seeds of trees, create shelters for several species, promote nutrient cycling, enhance food availability and quality for other species, and they open up woodlands. All of this is part of their functional role, and elephants that are not confined to small reserves, seldom, if ever, destroy ecosystems or change them irreversibly.

Due to their body size, their influence is strikingly obvious to the casual observer, but equally striking should be the consequences of their absence, which also changes ecosystems. Elephants reduce tree cover, especially near rivers and other watering points. That said, it is equally important to realise that savannahs influence elephant populations, their activities, their roaming behaviour, their selection of food and habitat, their breeding rates, survival rates and ultimately population growth and numbers.

Estimates of the number of trees destroyed by elephants vary greatly, as do the number of trees that are present in any given place. Years ago scientists suggested that each elephant in the Luangwa Valley in Zambia killed some 40 trees per year, while work in eastern Botswana during the 1980s came up with a figure of 1 200. Another study suggested that 1 500 trees may be taken yearly by each elephant in north-western Zimbabwe. However, it is not about the actual number of trees taken, it is more about the fraction of available trees that might be destroyed.

"Elephants seldom, if ever, destroy ecosystems or change them irreversibly."

Work in Kruger suggests that one per cent to four per cent of all trees in the park are destroyed each year by elephants. This level of damage may be supportable, but can transform the composition and structure of the park's vegetation. Yet it is not elephants alone that kill trees, but the combined effects of fire, floods, droughts, disease, and herbivores. Nevertheless, ardent observers may argue that it is not the number of trees killed that is important, but rather the reality that elephants may kill large trees. I agree and therefore feel that we need to know why elephants break large trees.

It is possible that boredom and displacement activities during shade-seeking, enforced by spells of high ambient temperatures, rather than nutritional needs alone, could explain some incidences of damage that culminate in the demise of trees. Increased incidences of extreme temperatures due to climate change may boost such occurrences.

We also know that the disappearance of elephants from large stretches of natural landscapes may account for the development of dense woodlands, especially along the banks of rivers that were frequented by elephants before their demise through hunting for ivory during the late 1800s and early 1900s. The absence, combined with the aggressive spread of the exotic rinderpest that dramatically reduced antelope numbers across southern Africa, could account for the development of these woodlands. In the mid 1900s these woodlands might have been a typical feature of our then newly protected parks. However, rather than typical, such woodlands echoed the response of nature to man-induced disturbances brought about by the over-hunting of elephants and by wildlife succumbing to an exotic disease.

"Trees die through the combined effects of old age, fire, floods, droughts, disease, and herbivores."

“Zonation of land has already eased conflict in some places, as has the development of community-based conservation and development projects.”

PROVIDING FOR THE SPATIAL NEEDS OF ELEPHANTS

What have we done for elephants?

People have done a lot for elephants and continue to do so. We are well aware of their plight, and have legislation to protect elephants. We have set aside land to accommodate elephants, provided them with water where deemed necessary and we have fenced some of them off from the surrounding landscapes. We no longer cull elephants, but in some places we continue to hunt them.

Criminals kill them for their ivory, and conservation authorities occasionally shoot elephants for their wrong-doings, such as crop raiding or when people are threatened. We also study them, hail them in high esteem and earn good tourist money from their presence in many of our protected areas. Overall, we have done a lot for elephants and should continue to do so, especially in the wake of the renewed onslaughts of poaching and the ever-continuing habitat destruction.

We have reduced their range

Historically, elephants may have ranged throughout much of southern Africa, especially during the wet season. They then could have restricted their dry season ranges to areas close to water, food and shade. Numbers could have been relatively high near rivers, as is the situation these days. However, in more recent times we have greatly reduced their range, more so in South Africa and Malawi than elsewhere in southern Africa.

Elephants do come into conflict with people

Frequent reports on human-elephant conflict (HEC) stress the serious nature thereof. Levels of frustration are high in many rural areas where people and elephants live side by side. This usually is the case where people find life most secure – in the proximity of water and where soils are fertile for growing crops, exactly the places that provide prime habitat for elephants! Elephants raid crops mostly at the end of the wet season when crops are just about ready for harvesting. Raiding generally takes place at night and most frequently involves bull elephants. Crop raiding is also most likely to occur near protected areas; however, elephants on rural land do not necessarily come from protected areas.

HEC mostly occurs where people live in ideal elephant habitat, especially along river courses where soils are fertile. HEC therefore seems to be a spatial problem. The solution may be in allocating appropriate space, which may include actions that zone land use. Zonation of land in consultation with both parties (people as well as elephants) has already eased conflict in some places, as has the development of community-based conservation and development projects.

In many places we have fenced elephants in, and they no longer are free to roam and forage as and where they prefer. This is the case for some elephants living in South Africa, Malawi and Namibia. Fences along international frontiers and veterinary fences hinder large-scale movements, as do intensely transformed landscapes along the boundaries of some protected areas.

We have given them land

Elephants are where they are because of what we have done for them. Southern African nations collectively have set aside a third of their land for elephants and other wildlife. Conservation agencies have done much to nurse elephant populations onto the path of recovery following the decimation wrought by hunting for ivory prior to and during the early colonial years. Relief from intense poaching and continued legal protection also allowed some elephants to regain part of the land that used to be available to them beyond protected areas.

Today most savannah elephants live on protected land in Africa's Miombo-Mopani wilderness area that stretches across some 1.2 million square kilometres. It is also home to some four million rural people. About 70 per cent of the land in this area is considered relatively intact, and at least 36 per cent thereof is formally protected as IUCN category I to IV areas. Law also protects elephants that live on game management areas and communal conservation areas. These areas mostly fall into the IUCN V and VI categories, often adjoin formal protected areas and in some countries double the area of the protected estate. Therefore, elephants living in this part of Africa already benefit greatly from formal protection.

In South Africa several populations have been established across the country, mostly on private properties less than 250 square kilometres in area. This is a mere tenth the size of the typical home range of a free-ranging breeding herd living in larger protected areas where movements are not restricted by fences and the artificial distribution of water. Elephants on small protected areas therefore have no space to scatter across when the summer rains arrive. The consequent year-round use of the same land and food sources provides little opportunity for vegetation to recover from elephant browsing. Impact, therefore is not due to too many elephants, but merely due to elephants not having the opportunity to shift their ranges as the seasons demand. But, this anomaly does not only exist in small protected areas, it also occurs in some of the larger protected areas, specifically in those with plenty of artificial water points.

"Water pumped from boreholes served a purpose, but is now at the root of the so-called 'elephant problem' in several of our parks."



ARTIFICIAL WATER POINTS: AS OUTDATED AS TRUNK CALLS?

We have given them water

Most large protected areas where elephants live include or border on large rivers with ample water supplies. Protected areas also include vast stretches of land without water to drink during the dry months of the year. Here perennial streams and shallow depressions that fill with rainwater during the summer rains dry up during the winter months when it does not rain. Most wildlife concentrates on areas close to water and watering places that were established to attract wildlife and to boost animal numbers in protected areas. This made sense in the early days of conservation, when it was important to regain wildlife in newly established conservation areas. Elephants and other wildlife had to be nurtured to regain desired numbers and to flourish in protected areas. However, things have subsequently changed rapidly. High numbers and intense use of areas around water sources degraded vegetation, which in some places motivated culling, a management activity discontinued throughout the sub-continent.

The creation and maintenance of artificial water points pumped from boreholes is well meant and even served its purpose, but it is now at the root of the so-called ‘elephant problem’ in several of our parks. Though not fenced, conservation areas such as the Hwange National Park in Zimbabwe and the Khaudum Game Reserve and Etosha National Park in Namibia are swamped with artificial water points. In recent years drinking troughs have also been established in several places in Botswana’s Chobe National Park, while water points in South Africa’s Kruger National Park have been reduced. Water provisioning may suit tourism needs, but accentuates impact, degrades food sources and intensifies die-offs during droughts. The provisioning of water is obviously not a lasting solution for these problems. It may seem counter-intuitive, but scientific studies suggest that in some protected areas, it is far more productive to reduce the number of artificial water holes, thereby providing a more durable solution to the perceived elephant problem.

Water supplied artificially boosts **elephant** population growth

We know from our recent work that elephant calf survival during the first three years of life depends on sufficient rainfall during the year of birth. This effect is weak in unfenced protected areas where water supplies are not supplemented but much stronger where water is supplied and where movements are restricted by fences. This suggests that these management actions cause resource depletion by altering the roaming and foraging behaviour of elephants. The expected increased occurrences of drought due to climate change may well occur in the places where elephants will be most severely affected, as would be for other species living there. Conservation management will thus be well advised to reduce artificial water supplies and where possible, lift fences so as to reduce impact on vegetation and soften the impact of droughts on wildlife.

We have fenced them in and managed their numbers

In early colonial days, diseases such as malaria and sleeping sickness kept people from occupying large tracts of land. Some of this land became protected areas where wildlife was expected to flourish. At that time, and at times since then, it was important to attract wildlife to the newly established protected areas, to keep them there and to keep people out of these areas. This was best done by way of policing and fencing. Putting fences around land set aside to protect game and other species from people and vice versa seems sensible – after all, good fences supposedly make good neighbours. However, at times good fences may be counterproductive, restricting movements of large animals, eventually at a cost to the land and habitat meant to be protected, because fences prevent elephants from dispersing in response to food scarcity.

THE DOGMA OF WILDLIFE MANAGEMENT AND CARRYING CAPACITY

Agricultural logic dominated the early days of wildlife management. Many managers at the time believed that wildlife numbers had to remain below the limits dictated by the land. They called this 'carrying capacity' and thought that numbers would only stray beyond this level when the natural balance was disrupted. Managers became the keepers of this balance and whatever they perceived as threatening this balance had to be controlled. Logic therefore dictated that numbers had to be reduced to keep nature in balance.

As an upshot, wildlife was managed intensively during the 1960s, '70s and '80s. Wildlife management became a science in its own right, and some university courses focused on the dogma of controlling numbers as a primary conservation measure. For about thirty years, wildlife in some protected areas was managed to follow models that set numbers at approved levels or 'carrying capacities'. For elephants this came down to 'about one elephant per square mile'. Consequently at least 46 000 elephants were culled in Zimbabwe alone. The fate was similar for about 2 000 elephants in Uganda, 1 600 in Zambia, 800 in Namibia, and nearly 17 000 in South Africa.

Managers in those days did what they and some scientists thought was right. They found support in the reasoning of the day, but in most places the impact of elephants on trees continued despite culling. In retrospect, it seems that the control of elephant numbers did little to address their impact. This is not surprising considering that impact is due to factors other than numbers alone, a position also held by several scientists that in those days already opposed culling as a method to mitigate impact.

Fences and movements

Our satellite tracking studies show that elephants use areas close to fences more intensely than those further afield. This bundling of activity intensifies the impact of elephants on vegetation and creates so-called edge effects. In some places fences disrupt movement patterns and this also amplifies elephant related impact on vegetation. A lack of seasonal dispersion due to fencing or insufficient space may force elephants to use the same habitat throughout the year and increase local impact on vegetation. Fencing also hinders dispersal when resources become limiting.

Re-thinking Conservation and Wildlife Management

Elephants have responded to management

In southern Africa most elephant populations are not fenced-in, and not exposed to management interventions other than the provisioning of water and the control of poaching. In stark contrast, South African populations have been exposed to intensive management. Populations here have been fenced, additional water has been provided, and numbers have been reduced through translocations and culling. Our research shows that South Africa's intensely managed populations increased at rates that were both faster and less variable than populations elsewhere in Africa, suggesting that the conditions created by management stimulated population growth. This is not surprising, because elephant populations, like those of all other species, do respond to resource supply and the protection afforded by conservation management. On the other hand, the inhibition of dispersal may also be largely responsible for higher population growth rates in the fenced South African populations as compared to open populations elsewhere in Africa where immigration and emigration do occur.

"Our approach engages the causes of the apparently high abundance of elephants in parts of southern Africa. It moves away from the practice of dealing only with numbers (symptoms) when managing the impact of elephants on other species. While providing an ecological basis for the development of elephant management options, this needs to be melded with social, political and economic realities through southern Africa. In this regard we are encouraged by the ongoing development of several Transfrontier Conservation programmes and Peace Parks across the region."

(van Aarde and Jackson, 2007)

The undesirable responses of elephants to management continue to stimulate discussion and research. Some people continue to call for further interventions. Such interventions seem sensible, but only if we learn from them, and respond by adapting our actions to improve the likelihood of achieving our goals. For instance, we now know that elephant numbers increased when culling was halted. This also happened in places where a few individuals were released into vacant landscapes, or where emigration (dispersal) was hindered by fences, or where additional water was provided, or in any combination of these. We cannot ignore lessons from the past and these should pave the way to continuing adaptations in management through learning. Our knowledge-base will continue to change and this means that management interventions should be dynamic and change with time. This could lay the groundwork for re-thinking conservation and wildlife management, not only for elephants, but also for other species. To learn by 'trial and error' makes sense. It provides a solid foundation for experience-based conservation management, especially when responses to management are documented properly.

MIMICKING AND NURTURING THE FLUXES OF NATURE

Our management philosophies have changed

Many of us understand that water provisioning drives the impact that elephants have on vegetation, especially when fences restrict roaming. We also know that some international borders that are fenced hamper linkages between preferred habitats, especially in places where people have transformed habitat. The control of numbers to reduce impact, however, is no longer the focus of management, especially for elephants in relatively large parks. The polarisation and heated debates of the past four decades also seem to have faded away. Views to the contrary are limited to a few that uphold outdated aspirations and ideologies. Their 'command and control' approaches to keep the 'balance of nature' have largely given way to a more informed standing that management directed at conservation should mimic and nurture the fluxes of nature. For elephants the focus therefore falls on the land and habitat, rather than on numbers.

Public opinion on this is also changing. For instance, half of 268 newspaper reports published over five years in three South African newspapers support translocation, fertility control, range expansion, and water management as alternative approaches to culling to address alleged overabundances of elephants in confined areas. Managers of small parks with confined elephants also are increasingly in support of contraception as a means to reduce population growth rates.

We have set new conservation standards

For elephants, life across southern Africa has changed greatly over the last two decades and even more so over the past five years. Public debate and the informed participation of society have assisted these changes. Modern day management focuses on the land and aims to restore and maintain ecological processes rather than limiting populations. Emphasis has shifted to providing for the spatial needs of elephants, protecting sensitive areas through the exclusion of elephant activity, and managing or restoring the land where they live by reducing water supplies rather than elephant numbers to ameliorate impact. The so-called 'symptomatic' approach to elephant management is hence giving way to a more 'systemic' approach that deals with finding solutions for the causes rather than the symptoms of elephant problems.

For elephants, management advice these days favours a natural, self-supporting spatial dynamic. Where applicable it calls for the delineation of linkages between isolated populations in the form of transfrontier conservation areas, transboundary protected areas and megaparks. Leading conservation authorities, such as South African National Parks, have initiated some of the regional management activities to remove fences around parks, reduce artificial water sources and promote cooperation between countries and landowners. Neighbours are keenly participating, and the Peace Parks Foundation is one of several prominent authorities that facilitate the development of transfrontier conservation areas across southern Africa. In southern Africa alone, ten of 13 proposed transfrontier conservation areas will have conservation implications for elephants. We are at the very early stage of knowing how elephants and other wildlife will respond to these developments.

WHAT MORE CAN WE DO FOR ELEPHANTS?

We can learn from experience

We know that poaching for ivory and habitat loss at the turn of the previous century changed things for elephants, as did the establishment of protected areas and the consequent well-intended bundling of elephants into these areas. This was the right thing to do at the time, but for elephants there was a price to pay. They lost land and populations became fragmented. Elephants could no longer disperse and this boosted numbers. Crowding near water destroyed vegetation. In some places this justified culling operations. Some 30 to 40 years later, the ineffectiveness of culling to reduce impact became apparent and consequent changes in management paradigms now emphasise the management of impact rather than elephant numbers.

Despite these lessons, the diversity of opinion on how to deal with elephants persists for several reasons. Management objectives differ between countries and between state owned and privately owned land. Aditionally, conflict and the mitigation thereof in rural areas also differs between countries, and potential solutions are often case specific and inspired by political and socio-economic realities. Across southern Africa, management other than retribution in conflict situations these days includes the provision of water in some places, the reduction of watering places in others (notably Kruger), the control of movements through fences, the restoration of movement patterns through fence removal, and the inhibition of breeding in small confined populations that were established through the translocation of elephants from elsewhere.

We should redefine the elephant problem

The 'elephant problem' is real, but poorly defined. To some people the problem is one of too many elephants, while others see the problem as one of too few elephants. For others the problem resides with the impact of elephants on vegetation and other species. For people that live with elephants in rural areas, problems relate to elephants destroying crops and threatening their lives. Consequently, past management focused on either dealing with numbers or on activities to protect crops and people. Problems persist despite the myriad approaches that have been used or that are in use to deal with these. This is not surprising when considering that solutions are difficult to find for poorly defined problems. Solutions then tend to focus on the symptoms rather than the causes of the problem. For instance, elephant numbers beyond or below expectation at a given place are merely symptoms of a problem, the problem being a lack of appropriate space, or human interference with the way that elephants arrange themselves across space. Several conservation authorities and NGOs support this view. In reality, the problem that we now face is whether the space assigned to elephants provides for their needs and will ensure their persistence and that of other species with which they share the land.

We should set sensible conservation and management standards

Sensible conservation focuses on the persistence of species. This should also be the aim of sensible management. A way towards achieving persistence is to provide and maintain diverse landscapes on protected land. Under ideal conditions the land should comprise both prime and marginal habitat, some areas should be vacant while others should be occupied, but at varying densities. Densities should vary naturally and individuals should be free to disperse in response to the patchiness in resource quality over time and across space. Under such conditions, populations might change into sub-populations that will be separated by distance and have different survival and breeding rates. Collectively these units could form a metapopulation, with incidental and low rates of movements between sub-units. Restoring such a structured population makes conservation sense as it ensures persistence where land is sufficient to provide or to include spatial variability (heterogeneity) in living conditions.

We should stop interfering with key resources

Water is a key resource for elephants. The distribution of water dictates where elephants live, the distances that they roam and the impact that they have on other species. It therefore is not surprising that increased water supplies have induced unwanted responses and that the reduction of water supplies is a management option that should be considered. The reason for this is simply that the impact of elephants on trees and other vegetation depends on distance from water – short distances between many watering points spreads this impact, reduces roaming distances and hence decreases stress, especially on young elephants. Reduced stress increases survival and therefore the rate at which populations grow, which ultimately results in high numbers. Increased numbers in confined areas spreads elephants more evenly across the land and leaves little land unaffected and spared for droughts when marginal habitat buffers the impact elephants may have on prime habitat. Numbers and land use patterns altered by water provisioning therefore degrade habitat. Reducing water points to reduce impact therefore makes conservation sense.

Reducing water points may increase the impact of elephants on vegetation at the remaining water points, but will relieve vegetation elsewhere and provide respite for its recovery. In the same vein, we know that the concentration of elephants at remaining water may intensify density related effects that could reduce calf survival and breeding rates, and ultimately balance population growth. Furthermore, increased roaming distances enforced by greater distances between remaining water supplies and quality food might reduce the likelihood of survival of calves in breeding herds and further reduce population growth. However, this might only hold for relatively large areas where elephants can roam over large distances. Small protected areas are unlikely to include situations where elephants will be forced to move long distances between water points and where living conditions vary enough to stem calf survival. In addition, distances between watering points may be too short to provide sensitive vegetation the opportunity and the space to escape from the harmful effects of elephant foraging. In such places, we should explore alternative management options, not least of which may include the removal of elephants. At best, the practice of founding elephant populations on relatively small areas should be discontinued as elephants forced to live in such areas generate more problems than their conservation worth.

Reducing water points may make conservation sense

Our research shows that the areas of elephant home ranges decrease as the number of water points increases. In protected areas where watering points are close to each other, elephant ranges are small and daily roaming distances short. Conceivably vegetation in these ranges is more intensely used than where water points are more dispersed and less dense. Impact thus once again is a function of spatial use patterns enforced by the distribution of water points. Reducing the number of water points to restore spatial use patterns therefore might alleviate the impact of elephants on vegetation.

MAKING SPACE FOR ELEPHANTS

We could remove some fences and give elephants space

Removing fences to provide sufficient space for elephants could reconcile twin conservation goals. It will reduce impact on habitat and provide the variability in living conditions that could limit population numbers and growth rates across a region.

Removing fences to connect with neighbours that have similar conservation aspirations is nothing new and started back in 1994 when fences were removed between Kruger and some of its neighbours to the west. More recently, part of the fence between Kruger and Mozambique's Limpopo National Park was removed to establish the Greater Limpopo Transfrontier Park, an initiative that will eventually represent a six-fold increase in the size of Kruger alone. Other similar incentives with wider visions for conservation that will incorporate some of the aspirations of local rural people are also underway, notably the Kavango-Zambezi Transfrontier Conservation Area (KAZA-TFCA). This initiative caters for nearly 220 000 elephants over a total area of 278 000 square kilometres and is based on agreements between Angola, Botswana, Namibia, Zambia and Zimbabwe. Here, few fences exist, but those between Namibia and Botswana hinder elephant movement. The notorious veterinary control fences in Botswana also obstruct movement but contain the spread of foot-and-mouth disease.

In the many cases where the dropping of fences is not feasible, landowners and managers face serious threats, as elephants confined to small protected areas can erode vegetation and habitat for other species. In these areas contraception could be implemented to prevent population growth, but this will not reduce the impact that elephants have on vegetation. The management of elephants on small areas should preferably start long before impact on the land and vegetation becomes undesirable. In these situations the inhibition of breeding makes sense, not to reduce impact, but to avoid it. The near exponential development of techniques to inhibit breeding therefore is a promising animal husbandry tool but is not realistic for large populations and hence not relevant for conservation.

Addo's elephants as a case study

From the elegant reconstruction of the history of the elephant population of the Addo Elephant National Park by other scientists we know that isolation through fencing between 1931 and 1954 induced several anomalies. With no male immigrant arriving in Addo over a period of some 70 years, rates of inbreeding skyrocketed. From 1954 to 2000 a single bull sired all the elephant offspring in this park and this possibly explains why the number of tusked females here decreased from about 50 per cent in 1930 to about three per cent in 2000. Furthermore, bulls here were killed in fights more often than anywhere else. Seventy to 90 per cent of deaths among bull elephants over a period of seven decades were as a result of fighting. Fencing therefore made life more risky for bulls. In Addo, multiple watering points reduced the distances over which breeding herds had to roam, thereby reducing calf mortalities induced by the stress that comes with long distance movements between food and water, thus explaining the unusually high growth rate of the population. Over the last few years things have changed for elephants in Addo. Bulls have been introduced from elsewhere, fences have been shifted to provide more land and water provisioning is under experimental manipulation.

Elephants need space

The home ranges of elephants that we tracked through satellite technologies are mostly confined to areas within the boundaries of clusters of primary (IUCN category I to IV) and secondary (IUCN category V and VI) protected areas across southern Africa. Elephants that we studied did not distinguish between these categories, but their roaming beyond primary protected areas suggests that national parks alone were not meeting their needs. Cows mainly left primary protected areas during the wet season when rainfall increased the availability of water across the landscape, whereas bulls roamed widely throughout the year. Roaming onto areas beyond national parks was not a function of elephant densities in parks. This study highlights the importance of space, collectively provided by primary and secondary protected areas, for elephants.

Ecological networks can temper impacts and maintain biodiversity

We could develop ecological networks

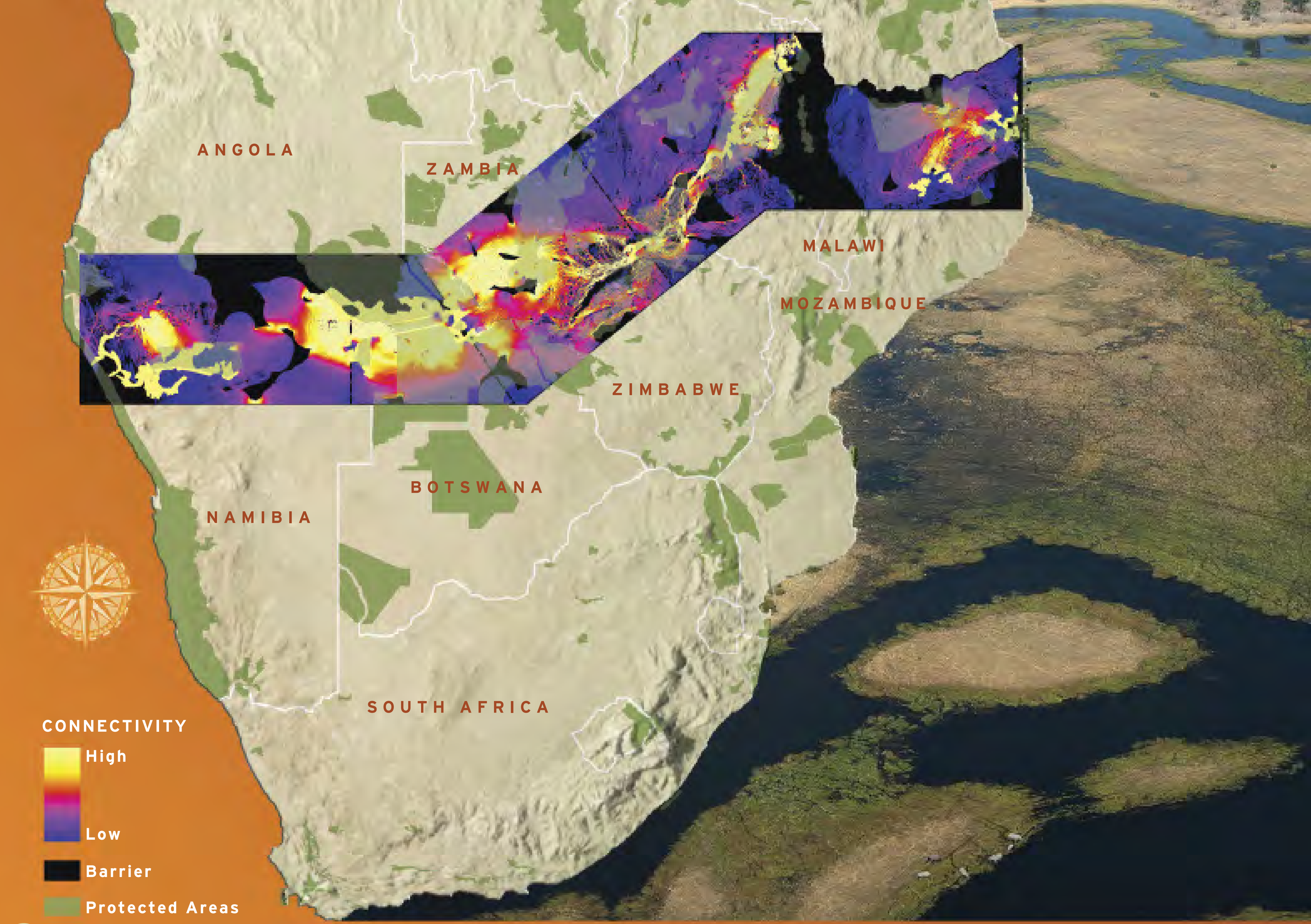
Sensible ecological networks incorporate the varying environmental conditions that cater for the ecological processes that enable species to persist. Such conservation networks differ from small and isolated protected areas that fail to provide for ecological processes and that need to be managed intensely and at a high cost. These isolated areas therefore are highly artificial, ecologically dysfunctional and natural processes cannot temper elephant impacts and maintain biodiversity. Incorporating isolated areas into networks will change this. This makes sense when considering that the effectiveness of protected areas is not just about quantity, but also about their distribution and location. We know that many small isolated parks are not as effective as a few networks of large, interconnected parks.

Securing land for conservation is justified by our commitment to maintain biological diversity. Biodiversity is more than just a stamp collection of species. It also includes the natural processes that enable species to persist. Conservation should aim to sustain these processes, which due to the varying environmental conditions typical of African savannahs, calls for the allocation of space configured according to the needs of species. Space that includes diverse living conditions enables habitat selection and brings about the uneven distribution of individuals across the land. Under certain conditions habitat selection may structure a population into sub-populations with differing dynamics. The development of ecological networks will provide for these dynamics.

Ecological networks could extend beyond the boundaries of present national parks. The reason is simple. Land beyond protected areas, even that occupied by people, also houses much biodiversity and can link populations confined to existing parks. Conservation related land uses in areas that surround national parks could also buffer parks from the negative effects of isolation, area and edge effects on species persistence. For this to happen, people living alongside parks need to benefit from and not be threatened by wildlife and vice versa. In many places in Africa this already happens, as some of the major national parks are surrounded by game management areas that also cater for the interests of the local people that live there. Benefits to people often are coined in financial terms, but there could be others, such as career opportunities and the development of infrastructure provided by and maintained through conservation channels.

Would elephants benefit from ecological networks?

Indeed, elephants would benefit, as would other species. Networks based on the needs of elephants would provide for the uneven distribution of elephants, reduce impact and reinstate the processes through which numbers change with time and across space. From our recent work we know that elephants do not distinguish between primary (IUCN categories I to IV) and secondary (IUCN categories V and VI) protected land, which is inhabited by few people. However, some clusters of primary and secondary protected areas do not yet form ideal linked networks that could reinstate the natural dynamics that stabilise elephant numbers and their impact on the environment. The KAZA-TFCA, which straddles the borders of five southern African countries and may incorporate nearly half of the region's elephants, is probably an exception. We still have too few networks of conservation areas that collectively cater for elephants. We are fortunate that land has been set aside for conservation, but it seems that many protected areas, especially those developed on private land or as provincial parks, are failing to ensure the persistence of biological diversity.


ANGOLA
ZAMBIA
MALAWI
MOZAMBIQUE
ZIMBABWE
BOTSWANA
NAMIBIA
SOUTH AFRICA
CONNECTIVITY
High
Low
Barrier
Protected Areas

Could ecological networks link elephant populations?

The answer is a resounding yes. I base this statement on the 'opinions' of a large number of elephants that we have tracked over the past ten years. Based on our analyses of patterns of habitat selection by these elephants and through the application of Circuit Theory we now know that much of the land beyond protected areas is still suitable for the development of ecological networks. Such development could expand southern Africa's conservation areas and link elephant populations. These networks could stretch from west to east across the sub-continent and could cater for the habitat needs of elephants and will benefit many other species.

Factors limiting connectivity across southern Africa include access to surface water in the west and a high human density in the east. For instance, elephants in the Etosha are effectively isolated by the lack of water and steep terrain in areas to the east.

Elephants recolonised areas in southeastern Angola after the civil war ended in 2002, but due to habitat limitations it is unlikely they will cross the arid regions of north-central Namibia and south-central Angola. On the eastern side of the sub-continent, the potential link between Luangwa in Zambia and Niassa in Mozambique is limited by high human density in Malawi. Unfortunately, Malawi has almost no areas outside of parks and game reserves where few people live and where linkages could connect elephants in Luangwa and Niassa with each other. These problems aside, opportunities exist to link existing protected areas into three colossal ecological networks that cover the range of most of southern Africa's elephants. However, this is all on paper – the realities still need further investigation, on the ground verification, societal input and agreement, as well as political will. This is one of our future responsibilities to elephants.

Circuit Theory to identify suitable habitat to extend networks

By consulting with elephants, we know where they prefer to live. They like flat terrain near water with moderate tree cover and, preferably, far from people. We use this information and apply it to areas where elephants do not currently exist, to see if high quality habitats for elephants exist elsewhere. The purpose of this is to see if existing parks and protected areas can be connected; allowing elephants to move more freely between these areas and reduce locally inflated elephant numbers. We first identify areas which could be suitable for elephants across southern Africa. It effectively allows us to test whether a string of high quality habitats exists which could connect existing parks. Using the resulting map (page 44), we can visualise and predict how elephants will 'flow' across the landscape.

About space

Space is not merely size. Size is not what matters. It is about the variety of resources, the distances between these resources, the connectivity between these resources and what happens to these over time and across space. That's what matters. Space thus includes variability in living conditions, the distribution of and distances between essential resources, the connectivity between ideal habitat, and the configuration of ideal and marginal habitat, all of which determine how elephants respond to space. Knowing how elephants respond to space is at the essence of managing space to provide for their persistence, for the persistence of species upon which they feed and species with which they live. Applying such knowledge can provide for a new dawn in conservation management. Elephants need this, and so do we.

What else could be achieved through the development of ecological networks?

We could secure species populations, evade extinction crises, improve land use options and extend conservation benefits to a wider spectrum of society. We know from recent research that species in protected areas are not freed from the extinction crisis. Much has been written on the reasons for these failures, but most thereof boils down to a lack of sufficient and efficient space. Securing space to ensure that biological diversity will be maintained and that all species will persist is in reality beyond the abilities of relatively small fractions of land that have been set aside for conservation. Space can be provided by linking isolated and relatively small protected areas into ecological networks. Space also can be secured by extending conservation incentives to areas in the matrices that surround protected areas. Several landowners and countries in southern Africa have done so. Here many of the larger primary protected areas (i.e. the IUCN categories I to IV protected areas) are surrounded by secondary protected areas (categories V to VI), with no hard boundaries or fences between them. Elephants that live in these primary protected areas roam onto secondary protected areas, where few people live.

The call for space is no longer new nor is it novel and mostly prides itself in promises of the economic development of rural societies, on sharing conservation benefits among land use options and on catering for ecological processes. These processes include space or connectivity to allow natural movement patterns of species. Extending space or developing networks of protected areas through corridors that link existing conservation areas features high on the agendas of NGOs operating across sub-Saharan Africa.

How will elephants respond to ecological networks and space?

The linking of land into ecological networks rather than managing numbers and providing artificial watering points makes ecological sense for elephants. But do elephants respond to this? We have one case study to reflect on the recent expansion of South Africa's Kruger National Park.

For elephants in South Africa's Kruger National Park things will never be the same. As a result of the foresight of Kruger's managers, since the 1990s Kruger has shed its legacy of confinement, artificial watering points and culling. Here culling was discontinued in 1994. At about the same time management started reducing the number of water points in Kruger, from some 340 in 1995 to a mere 116 in 2008. Since 2002 part of the fence that earlier isolated elephants from landscapes to the east was dropped. The space for elephants thus increased from ~20 000 to ~30 000 square kilometres. The population has now had the opportunity to respond to this changed environment.

Though still early days, our interpretation of yearly counts from 1967 to 2012 shows that the end of culling in 1994 was followed by a rapid increase in elephant numbers for some ten years, but since 2003 population growth has decreased rapidly. Numbers in areas further than five kilometres from major rivers fluctuated without any trend, and those within a zone of a five kilometre range of all major rivers have levelled off since 2003. Consequently population numbers in 2012 (~14 700 elephants) were just about 8 000 less than the yearly population increase of six per cent predicted by others. How do we account for this difference?

A first response would be that 'they are now living elsewhere'. For Kruger that elsewhere could be either to the east, west or north, but properties adjoining Kruger now only account for about 3 000 elephants and not for the projected ~8 000 elephants. Realised population growth thus must have been considerably lower than predicted. The levelling-off of numbers in Kruger is similar to that which we have noted for long-term and statistically sound census data elsewhere; 22 of 36 populations across southern and East Africa have stabilised in numbers for at least ten years. Modelling suggests that rainfall and related food availability explain the level at which these populations have stabilised. It is too early to predict long-term trends in elephant numbers in Kruger, but for now we have some support for the notion that numbers will fluctuate and stabilise in response to the restoration of natural limiting processes. Management that nurtures this approach is steering a new era of conservation that provides for a transition from static to dynamic management that considers the responses of populations to changes in resource availability.

More importantly, however, is that Kruger's elephants now operate as distinct demographic entities with differing birth and survival rates, and hence as a type of metapopulation. Reliance on a more natural distribution of water as a key resource now probably allows for variability in rainfall to exercise stronger influences on breeding and survival rates. In essence this should induce greater variability in growth rate and ultimately in the stabilisation of the population. This suggests that conservation goals that mimic natural processes can be achieved through appropriate management. Such population structuring would maintain genetic variability as expected where elephant populations have not been interfered with. Maintaining genetic structure is part and parcel of responsible conservation.

Future conservation in our part of the world is more than the efforts we put in place to manage numbers in fenced-off places. Conservation without borders may well become the focus of most of our future. After all, Africa has much to offer.

Are elephant populations structured?

Space provides opportunities for the structuring of populations into sub-units that differ demographically and that might be genetically distinct. Our ongoing genetic, spatial and demographic studies suggest that elephants in the Kavango-Zambezi Transfrontier Conservation Area (KAZA) are structured in distinct spatial units. This is most probably because this region hosts one of Africa's elephant populations that have not been managed and are generally free to roam beyond country borders across a landscape of about 278 000 square kilometres.

Based on mitochondrial DNA sequences (representing maternal genetic characteristics) the elephants from KAZA's Hwange area in Zimbabwe appear genetically separated from elephants in Botswana and Zambia, possibly indicating that these elephants originated from different founder populations. Although mitochondrial DNA showed three genetically distinct elephant groups, nuclear DNA microsatellites (representing a combination of paternally and maternally inherited genetic characteristics) suggests high gene flow across the entire KAZA region, with genetic differentiation occuring solely at the edges. This genetic population structure is probably caused by social realities, where females tend to restrict their activities to small areas while male elephants roam widely across the landscape.

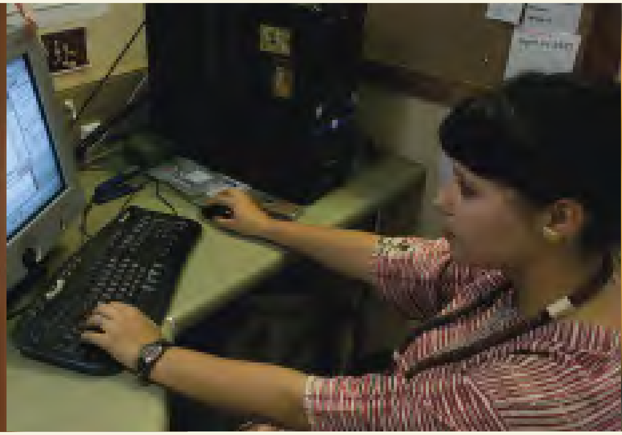
TO SUMMARISE

Where Are We?

- Our science-based understanding of elephants is much better than ever before.
- We now have less than half the number of elephants we may have had 50 years ago, and some populations are now more isolated than before, some are expanding their ranges, some are stable in numbers, some continue to increase, and some are threatening to collapse if left unprotected or unmanaged.
- For conservation, we have set aside about a quarter of the land available for elephants, but about 70 per cent of the presently known range of elephants extends beyond protected areas.
- Several protected areas are surrounded by human dominated landscapes and are not included into a greater network of sensible conservation areas.
- Conflict between people and elephants is probably now more frequent and intense than before, and the renewed poaching onslaught is eroding numbers in certain places.
- Elephant populations are still sub-divided into political and administrative rather than ecological units.
- We have entered an enlightened era where some authorities embrace the scientific approach to conservation, while others continue to ignore science and misinform society and support a 'command and control' approach to conservation.
- We have entered a time where animal welfare and compassionate conservation prevails – conservation that considers the needs of elephants rather than the demands of landowners.

Where Should We Be?

- We should live in an informed society that continues to embrace knowledge-based conservation management that benefits elephants without detracting from other species.
- Where appropriate, elephant populations should be linked and collectively should be stable in numbers, but numbers and spatial use patterns should change across space and with time.
- Where the spatial extent of elephants allows, we should develop linkages between populations along corridors that are based on elephant preferences rather than political, societal and socio-economic needs alone.
- Conflict between people and elephants should be minimised through acceptable zonation of land occupation, and we should strive to create a society absent of greed-driven poaching. Conservation should be based on ecological principles, while societal and acclaimed utilitarian needs should support conservation, rather than vice versa.
- Management should be informed by science and adapted to suit regional rather than local conservation aspirations.
- Politicians and other decision makers should accept that elephants do best when treated as ecological entities, where their responses to varying resources rather than perceived economic value assure persistence.



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CERU – THE ELEPHANT TEAM

The Conservation Ecology Research Unit was established in 1998 and is funded through grants from national and international organisations and private industry. These grants provide for the employment of research fellows, support staff and postgraduate bursaries. Research focuses on a scientific foundation for conservation and CERU is widely recognised for reaseach on the conservation and ecology of elephants.

Our scientific publications on elephants

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Cornelio Ntumi


Tamara Lee


Robert Guldemond


Camilla Nørgaard

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Jo Fourie

Pieter Olivier Morgan Trimble

Michael Mole

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Pieter Olivier

Carrie Roever

Shaun Rodrigues D'Araujo

Alida de Flamingh

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Kim Young

Jo Fourie Camilla Nørgaard

Rudi van Aarde Kim Young

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OUR SUPPORTERS

For the past ten years our research has benefited from the support provided by:

- Bateleurs
- BHP Billiton
- Botswana Department of Wildlife & National Parks
- Conservation International's Southern Africa Wilderness Programme
- Conservation Foundation Zambia
- Conservation Lower Zambezi
- Direcção Nacional de Areas de Conservação, Mozambique
- Elephants Without Borders
- International Fund for Animal Welfare
- Mozal Community Development Trust
- National Research Foundation
- Namibian Ministry of Tourism & Environment
- National Postcode Lottery, Netherlands
- Malawian Wildlife Department
- Peace Parks Foundation
- South African National Parks
- The Paul G. Allen Family Foundation
- Tracks4Africa
- US Fish & Wildlife Services
- University of Pretoria
- WWF (SARPO; Mozambique; SA)
- Wilderness Safaris
- Wings4Wildlife
- Zambian Wildlife Authority

Rudi van Aarde is a full professor at the Department of Zoology & Entomology in the Faculty of Natural and Agricultural Sciences of the University of Pretoria. From here he directs the Conservation Ecology Research Unit. He is widely recognised for his research on the ecology of elephants, especially for the development of the 'megaparks for metapopulations' concept that focusses on causes rather than symptoms of conservation issues.

He has authored or co-authored 175 peer-reviewed papers in prestigious scientific journals, 11 book chapters and numerous popular articles. Fifty eight PhD and MSc students completed their studies under his supervision, many of whom are now at the forefront of conservation-related research. Rudi is an active member of several scholarly societies, regularly reviews papers for high impact factor scientific journals and frequently advises industry, government and conservation organisations on conservation-related issues. The University of Pretoria has awarded him for exceptional academic achievement on four occasions, and he is a Fellow of the Royal Society of South Africa.

THE PHOTOGRAPHS

Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/400 sec. f/4.0
ISO 160

Addo, South Africa
Canon EOS-1D Mark IV
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1/1250 sec. f/3.2
ISO 200

Savuti, Botswana
Canon EOS-1D Mark III
EF 85mm f1.2 L USM
85mm
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ISO 320

Painting on door, unknown artist,
Bangweulu wetlands, Zambia
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Chobe, Botswana
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Etosha, Namibia
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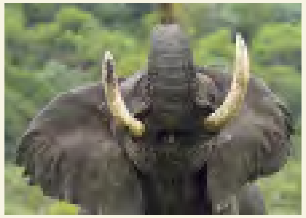

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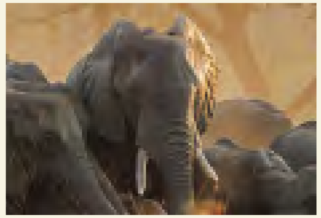

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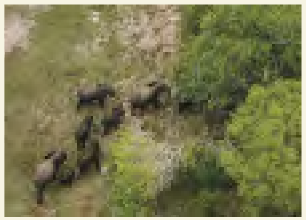

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South Luangwa, Zambia
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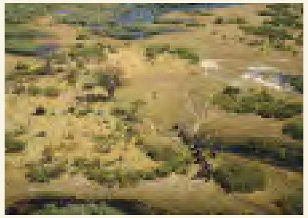

Selinda Spillway, Botswana
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Savuti, Botswana
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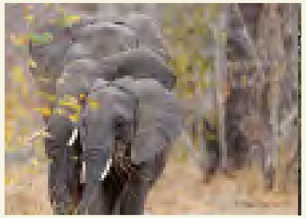

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Mapungubwe, South Africa
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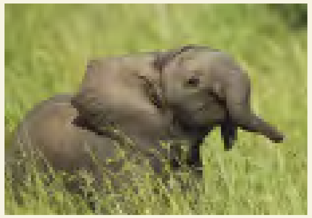

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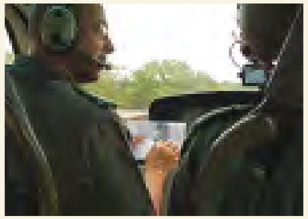

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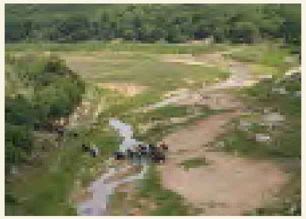

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Maruppa, Mozambique
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Kasane, Botswana
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Savuti, Botswana
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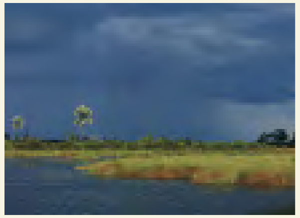

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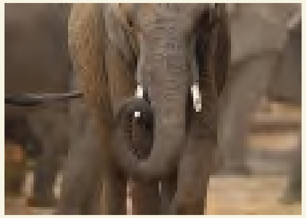

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ISO 400

Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/400 sec. f/6.3
ISO 250

Chobe, Botswana
Canon EOS-1D Mark IV
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Chobe, Botswana
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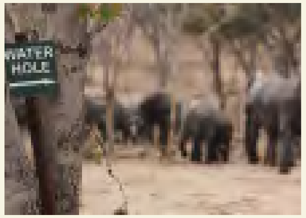

Chobe, Botswana
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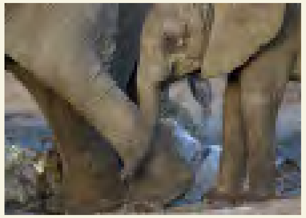

Chobe, Botswana
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Kruger, South Africa
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ISO 320

Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
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Northern Botswana
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Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/250 sec. f/4.5
ISO 400

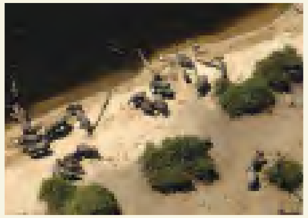
Kruger, South Africa
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/400 sec. f/3.2
ISO 200

Chobe, Botswana
Canon EOS-1D Mark II N
EF 500mm f4 IS II USM
500mm
1/400 sec. f/4.0
ISO 200

Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/200 sec. f/3.5
ISO 320

Addo, South Africa
Canon EOS-1D Mark II N
EF 28-70mm f2.8 L USM
45mm
1/2650 sec. f/4
ISO 250

Addo, South Africa
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/2000 sec. f/4.0
ISO 400



Chobe, Botswana
Canon EOS-1D Mark III
EF 28-70mm f2.8 L USM
70mm
1/4000 sec. f/4.0
ISO 250

Savuti, Botswana
Canon EOS-1D Mark III
EF 300mm f2.8 IS II USM
300mm
1/320 sec. f/5.6
ISO 400

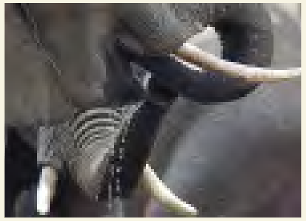
Northern Botswana
Canon EOS-1D Mark III
EF 85mm f1.2 L USM
85mm
1/40 sec. f4.5
ISO 50

Caprivi, Namibia
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/800 sec. f/3.2
ISO 400

Southern Mozambique
Canon EOS-1D Mark III
EF 24mm f1.4 USM
24mm
1/500 sec. f/5.0
ISO 200

Addo, South Africa
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/1250 sec. f/4.5
ISO 400

Savuti, Botswana
Canon EOS-1D Mark III
EF 300mm f2.8 IS II USM
300mm
1/250 sec. f/5.0
ISO 400

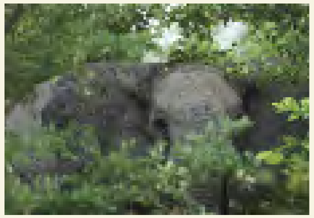


Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM +1.4x
560mm
1/125 sec. f/4
ISO 200

Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/1000 sec. f/4
ISO 400

Chobe, Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/200 sec. f/4
ISO 400

Kruger, South Africa
Canon EOS-1D Mark II
EF 400mm f2.8 IS II USM
45mm
1/1260 sec. f/4.0
ISO 250



Northern Botswana
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/2000 sec. f/5.0
ISO 400

Addo, South Africa
Canon EOS-1D Mark III
EF 300mm f2.8 IS II USM
300mm
1/200 sec. f/3.2
ISO 400

Addo, South Africa
Canon EOS-1D Mark IV
EF 400mm f2.8 IS II USM
400mm
1/200 sec. f/6.3
ISO 400

Addo, South Africa
Canon EOS-1D Mark III
EF 300mm f2.8 IS II USM
300mm
1/640 sec. f/3.2
ISO 160

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